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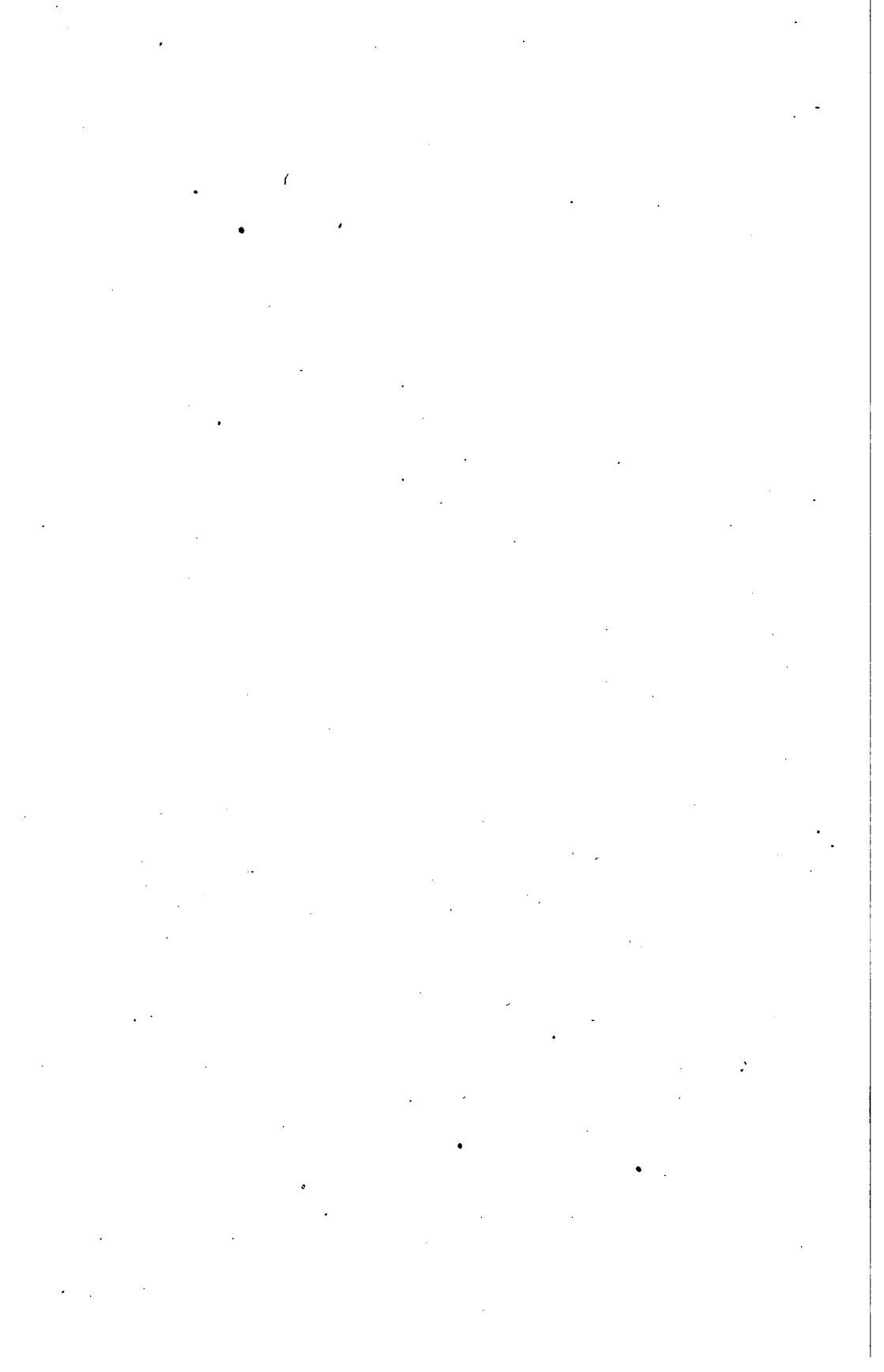
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NAVIGATION OF TENNESSEE RIVER.

REPORT OF THE SELECT COMMITTEE OF THE SENATE
TO EXAMINE AND REPORT ON THE NAVIGA-
TION OF THE TENNESSEE RIVER.

DECEMBER 12, 1906.
PRESENTED BY MR. MORGAN.

WASHINGTON:
GOVERNMENT PRINTING OFFICE,
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NAVIGATION OF TENNESSEE RIVER.

Mr. MORGAN presented the following

**REPORT FROM THE SELECT COMMITTEE OF THE SENATE TO
EXAMINE AND REPORT ON THE NAVIGATION OF THE TEN-
NESSEE RIVER IN RESPONSE TO A SENATE RESOLUTION OF
MARCH 2, 1905.**

DECEMBER 13, 1905.—Ordered to be printed, with illustrations.

REPORT ON THE TENNESSEE RIVER.

The Select Committee of the Senate to Examine and Report on the Navigation of the Tennessee River and other matters stated in the following resolution, having discharged that duty, report as follows:

RESOLUTION.

Resolved by the Senate, That a select committee of three Senators be appointed by the President pro tempore of the Senate, from States intersected by the Tennessee River, to examine into the navigation of the Tennessee River, and so forth, and to take into consideration the report of the Secretary of War on that subject made to the Senate at this session of Congress; and that said committee shall have leave to sit in the recess of the Senate at such places in the vicinity of said river as they may think necessary.

Said committee shall have power to send for persons and papers and to examine witnesses on oath, and may appoint a secretary and employ a stenographer. And the lawful expenses of such committee and its employees and of witnesses shall be paid, on the certificate of the chairman thereof, out of the contingent fund of the Senate, not to exceed one thousand dollars.

In the examination required by this resolution, the committee found authentic facts in the reports of engineers, made to the War Department, for the entire period in which the Government has been engaged in the improvement of the navigation of the Tennessee, the Ohio, and the Cumberland rivers, which are one common and connected system of navigable waters, and have had little occasion to look to other sources of information.

The committee have been careful to exclude from their report all disputed or doubtful statements of facts, and from their conclusions and recommendations all mere theories and suggestions as to the extent to which improvements may possibly be made in the navigation of the Tennessee River, and have endeavored to present the facts in support of their conclusion that this river can be made navigable to Knoxville, Tenn., for any boats that can run between

St. Louis and New Orleans. And they have reached the conclusion that the natural advantages are such that this great work can be speedily accomplished at a very low cost to the Government.

The mountain regions of the watershed of the Tennessee River are very extensive, including the western slope of the Blue Ridge from southern Virginia to the Smoky Mountain, and the divide that supplies the spring sources of the Alabama and Savannah rivers. And also includes the eastern and western slopes of the Allegheny Mountains and of Waldens Ridge from the divide that supplies the spring waters of Cumberland River to the Elk River Shoals.

It is possible by compact between the States of Tennessee and North Carolina to set aside reservations on the higher elevations of these mountains for preserving the timber and encouraging the young growth that will greatly modify the effect of heavy rainfalls which create floods in the Tennessee River. The European system of selecting the larger timber trees for sale would probably meet all the expenses of such parks.

Compacts between these States, with the ratification of Congress, would be efficient in this great work, to which the United States could make subventions to the immense advantage of a vast delta region extending to the Gulf of Mexico.

Your committee have not thought it to be a part of their duty to formulate such a compact, but they respectfully suggest to the Senate that a select committee to study and report upon this topic would be of much benefit to the future commerce of the country.

The ownership of the river beds is also an important legal question which should be considered by a select committee, whose report should be also considered by the standing Committee on the Judiciary.

I.

POWER AND DUTY OF THE GOVERNMENT.

The Government of the United States has, within the limits of the watershed of the Mississippi River, the paramount right of control of the navigation of the most extensive and important body of navigable waters in the world. On the high seas our right of control is confined to the narrow belt of the 3-mile limit from our coasts, which is an insignificant margin as compared with the breadth and length of our possessions on this continent.

The duty of caring for navigation corresponds with the wants and necessities of our own people, rather than with the mercantile advantage of our trade with foreign nations, and it has priority over the necessities of such intercourse.

DUTY OF ALL GOVERNMENTS AS TO NAVIGABLE WATERS.

Navigation, and all transportation, concerns the domestic welfare and prosperity of the people of the different nations of the world in a much higher degree than it concerns the national governments as competitors for commercial profits and political aggrandizement.

The people of all the world have natural and personal rights of transit on all the high seas, and the people of the several nations have

the same natural rights upon the water courses of their own countries; such rights, being the gift of God dedicated to mankind, belong to the people, and are held by all governments in trust for them. They can not be the subjects of monopoly without a violation of the laws of nature, and they are the proper objects of the care of all civilized governments.

The power of Congress to regulate commerce among the States is only a power given in aid of the execution of this right of the people, and is no more the basis of such rights than it is of the right of the people to travel from State to State on highways dedicated to the public use.

SCOPE OF THIS INQUIRY.

In presenting the claim of all the people of the United States, that the navigation of the Tennessee River shall be so improved as to be adequate to the importance of the commerce within its watershed that is already developed, and the vast stores of wealth it will certainly furnish as the facilities of navigation are increased, your committee does not fail to take into account the relations of this river to the other great rivers within the watershed of the Mississippi, and they only claim for the Tennessee River its just share in the assistance of Congress.

JUST RULE OF APPROPRIATION.

The contribution that is now made to commerce, and must hereafter be made in greatly increased volume and value, from the areas within the watersheds of each of these great affluents of the Mississippi River is the proper and just factor in the equation, that should control the appropriations that Congress should make to them, respectively, from time to time, for their improvement.

IMPROVEMENT OF THE MISSISSIPPI.

The improvement of the navigation of the Mississippi River is, properly, a separate proposition, which is for the benefit of the entire system, and should receive the united, faithful, and liberal support of the whole country as the most important and distinguishing feature in the commercial highways of this continent, which is without a rival in the geography of the earth.

The improvement of the Mississippi River, in securing a permanent channel and in regulating its depth and width is a work of the Republic. It is not less important to the whole country than the improvement of any seaport on our extended coasts. But it is, in a large degree, a work in which the laws of nature must have a controlling force and these laws, in their application to the Delta region, are not yet fully revealed, or understood.

Such works, within the Delta region, must be, for a long time, tentative and experimental. Correspondingly, the width and depths of the channels to be provided for the navigation of the affluents of the Mississippi, may be progressive, so as to conform to its capacity to bear their commerce, economically, and without interruption, to and from the Gulf of Mexico. Until the navigation of the Mississippi is established permanently, the greatest navigable depths of its affluents will not be fixed.

The present capacity of the Mississippi is in excess of the actual needs of the commerce that is now contributed by the great rivers that flow into it, and the improvement of their navigation, so as to double or quadruple their present tonnage, does not depend upon increased facilities in the Mississippi. Congress can proceed safely and with a free hand to improve the channels of the affluents of the Mississippi and to increase their capacity to fourfold the present tonnage without the apprehension of any difficulty as to the carrying capacity of the Mississippi.

PEOPLE WILL WELCOME TAXATION TO PAY FOR IMPROVED NAVIGATION.

If this is done the industries of the country will readily respond, and the resources of the people to bear the expenditure without inconvenience will be so increased that they will gladly welcome the opportunity to bear the burden of the improvement of these rivers, which are their joint property, not owned by combinations of capital, or controlled by agreements between common carriers.

If the taxation of the people for this purpose is doubled or quadrupled by such expenditures, they will get the benefit, and they never refuse the burden when the expenditure is necessary to the general welfare and is secure against the greed of monopoly.

Not only is it true that the free navigation of the water courses is secured to the people, individually and collectively, beyond the power of opposing monopolies and combinations to deprive them of these natural rights, but they are the only efficient rights and powers vested in the people that enable them to resist and control the monopolistic power that is now in the hands of railroad companies, to fix the cost of all transportation. Such considerations, which will be more specifically pointed out, not only justify, but they require Congress to take up the great subject of improving the navigation of the water courses that are parts of the grand system of commercial intercourse, included in the watershed of the Mississippi River.

II.

WATERSHED OF MISSISSIPPI RIVER.

The most valuable area within the limits of the United States is the catch basin, or watershed, of the Mississippi River.

Its value as property is measured by the immense extent of this area; by its varied topography, from river Delta, over plains and hill country to the highest mountain ranges that flank this great water course, in its entire length from Canada to the Gulf of Mexico; by its geological formations, which include all useful minerals, metals, rocks, and material that are known to science; and by its meteorology and geography, which include all the topographical and climatic features of the most favored regions of the Temperate Zone through 36° of latitude and 19° of longitude.

In this area are desirable, healthy locations for comfortable homesteads for many millions of families, abundantly supplied with rivers, brooks, springs, and wells of living waters, with forests of timber and mines of coal and iron and quarries of stone convenient for all the uses of the densest population.

An effort to enumerate these elementary necessities of the best and highest civilization of the leading race of mankind would fail to present even a just approximation to the grand aggregate. It is an almost limitless field for industry, for scientific development, for the beautiful works of art, and for the production of the highest types of mankind.

This area measures 1,240,050 square miles. If, like some interior states of Europe, our possessions were confined to this area of uplands, with no seaboard, they would still comprise the largest, the richest, and the most attractive state in the world. It reaches from Montana on the west to Pennsylvania on the east, between the crest-lines of the Rocky Mountains and the Appalachian Range, and from Canada on the north to the Gulf of Mexico on the south.

In this vast catch basin there is found an ample abundance of productive power to furnish rich supplies for all the present and future uses and needs of its inhabitants, and vast stores in reserve for the supply of other peoples and countries, with every useful and precious metal, with all the varieties of forest and fruit trees to be found in the Temperate zones, and many that are indigenous to the Arctic and Torrid zones. All the fruits that belong to the best soils and all the cereals and textiles that are useful for the support, comfort, and enjoyment of living creatures are grown in abundance in this magnificent region.

This outline of facts is stated as the basis of the underlying proposition as to transportation, which constitutes a feature of their greatest importance to the world and must be considered by Congress with most serious concern.

What myriads of Americans will inhabit the watershed of the Mississippi River in the ages to come and what duty rests upon Congress to render assistance at the earliest opportunity in so providing that these benefactions of Providence shall be secured to them and shall be made serviceable and useful in the highest degree, is a question that the present generation must endeavor to solve.

To this great question many proper answers may be given relating to government and to industrial and financial economy, but there is a primary question that now demands consideration among those that are of paramount importance. It is the question of the adjustment of the lines and channels of transportation to the physical geography of the watershed of the Mississippi River so that every navigable affluent of that central water course shall afford the full measure of all its advantages in due and just proportion, to assisting the commercial exchanges of people who are employed and are hereafter to engage in the productive industries of this great interior region of the United States.

These water courses are given us as a part of the physical geography of this grand area, without which it would be a vast desolation. Each channel is so designed as to contribute, separately, to the mobilization of the wealth and to the creation of the commerce of the system to which it belongs. They answer to the veins and arteries that bear the elements of life from a common center to all parts of a living man, and they can not be substituted, in their natural functions and offices, by any artificial contrivance.

They can be greatly assisted in their natural functions by open roadways and mechanical aids to transportation, such as railways, but they can never be supplanted by human enterprise or ingenuity.

They are to be cared for as highways, dedicated to the people who have the good fortune to occupy the lands of which they are a part, and as the gift of the All-wise.

From the first movement of commercial intercourse among the families of men, when camels were "the ships of the desert," and asses laden with merchandise climbed the mountain paths, the water courses and the seas have borne the burden of the concentrated commerce of nations, back and forth, to all the known places of the earth.

Christian civilization, which has always piloted commerce to new marts of trade and has supplied those that are established with the real burden of this wealth, was more than 5,000 years old when railroads were projected; and it will be ten thousand years older before the enterprise of man will find a substitute for water channels as the highways, and watercraft as the transporters of commerce of mankind.

In this view of the transportation question, it may be taken as an established proposition that the people of the United States will never abandon, nor will they neglect the preservation and improvement of the rivers that drain the vast watershed of the Mississippi.

Since 1820 about fifteen billion dollars of property and money have been invested and accumulated in railroads within the United States by private owners here and abroad. The enormous tax upon industry and commerce that is assessed by the railroads to pay interest and profit on these investments, and the just control of these assessments by competition, is directing the hopes of the people toward water transportation as the only certain and permanent relief that is in reach of the powers of government or of the people.

The following statement, taken from the latest census reports, shows the distribution of this basis of railroad assessments in the several States, and gives, approximately, a view of the enormous aggregation of power with which the people have to contend in their efforts to obtain justice in rates of transportation and against combinations that control the entire commerce of the country for selfish and mercenary advantage.

Water transportation is the great controlling power that stands for justice to the people in this emergency, and they are demanding that Congress will give it rightful encouragement.

According to a bulletin just published by the Census Bureau, the commercial value of the railroad property in the United States is \$11,244,852,000, distributed among the various States as follows:

Alabama -----	\$150,211,000	Louisiana -----	\$123,401,000
Alaska -----	100,000	Maine -----	80,146,000
Arizona -----	68,356,000	Maryland -----	132,342,000
Arkansas -----	124,626,000	Massachusetts -----	250,052,000
California -----	350,694,000	Michigan -----	277,597,000
Colorado -----	198,261,000	Minnesota -----	466,734,000
Connecticut -----	105,369,000	Mississippi -----	107,884,000
Delaware -----	17,285,000	Missouri -----	309,768,000
District of Columbia -----	5,578,000	Montana -----	196,209,000
Florida -----	80,476,000	Nebraska -----	263,170,000
Georgia -----	156,603,000	Nevada -----	43,745,000
Idaho -----	91,877,000	New Hampshire -----	79,786,000
Illinois -----	805,057,000	New Jersey -----	333,568,000
Indian Territory -----	79,405,000	New Mexico -----	86,400,000
Indiana -----	375,541,000	New York -----	898,222,000
Iowa -----	344,847,000	North Carolina -----	113,146,000
Kansas -----	356,356,000	North Dakota -----	123,890,000
Kentucky -----	155,772,000	Ohio -----	639,797,000

Oklahoma -----	\$78,668,000	Utah -----	\$90,325,000
Oregon -----	75,661,000	Vermont -----	37,311,000
Pennsylvania -----	1,420,608,000	Virginia -----	211,315,000
Rhode Island -----	25,719,000	Washington -----	182,837,000
South Carolina -----	75,500,000	West Virginia -----	201,799,000
South Dakota -----	49,646,000	Wisconsin -----	284,510,000
Tennessee -----	131,166,000	Wyoming -----	100,307,000
Texas -----	237,718,000		

GIVES MARKET VALUE.

The publication is intended to show the estimate placed upon the railroads for business purposes, and it purports to give their market value rather than the tax valuation. In a note it is explained that "the value submitted was determined not with a view to discovering a proper purchase price for the railways of the United States, nor as a basis for taxing these railway properties, but as one step in ascertaining for the Census Bureau the total wealth of the United States."

"Whether or not," the note continues, "the value submitted represents the value upon which the railways of the United States might properly be taxed depends upon whether the State undertakes to tax the roads at their full commercial value, including the values of both tangible and intangible property, or whether it seeks to confine its taxation to the value of the tangible property alone. In the former case the value submitted is believed to be substantially correct so far as it concerns the operating properties of the railways; in the latter case it is too high."

The percentage of tax valuations compared with the commercial value is given for the various States as follows:

	Per cent.		Per cent.
Alabama -----	35.9	Nevada -----	31.5
Arizona -----	9.7	New Hampshire -----	28.3
Arkansas -----	27.8	New Jersey -----	69.5
California -----	26.3	New Mexico -----	9.9
Colorado -----	25.0	New York -----	25.6
Connecticut -----	114.4	North Carolina -----	61.4
District of Columbia -----	44.6	North Dakota -----	18.0
Florida -----	27.1	Ohio -----	19.4
Georgia -----	40.3	Oklahoma -----	15.2
Idaho -----	11.0	Rhode Island -----	61.5
Illinois -----	63.8	South Carolina -----	39.0
Indiana -----	44.2	South Dakota -----	28.9
Iowa -----	16.7	Tennessee -----	46.6
Kansas -----	16.9	Texas -----	40.0
Kentucky -----	49.9	Utah -----	22.9
Louisiana -----	28.9	Vermont -----	73.3
Michigan -----	70.9	Washington -----	14.3
Mississippi -----	27.7	West Virginia -----	14.2
Missouri -----	31.6	Wisconsin -----	76.6
Montana -----	18.7	Wyoming -----	7.5
Nebraska -----	18.5		

The valuation given does not include the value of Pullman cars or private cars. The value of this equipment, independent of the commercial use to which it is put, is estimated as follows:

Pullman -----	\$51,000,000
Private -----	72,000,000

III.

INTEREST OF PEOPLE OF UNITED STATES IN QUESTIONS OF COMMERCE THAT ORIGINATE IN THE VALLEY OF THE MISSISSIPPI.

The United States has no local interest that stands above the prosperity of this great and unparalleled region, covering the richest possessions of the interior. In far-off periods it will be the competitor of the catch-basins of the Amazon and Orinoco in South

America, and of the Amur in Russia, and the Kongo in Africa, yet to be developed.

It will lead them and control their commerce, as it now leads and controls the industries of the Nile, the Danube, the Euphrates, and all the great river basins of Africa, Asia, and Europe, and of the Amazon. Those vast and fertile regions have failed to attract the people of the white race, or to hold them, while the Mississippi watershed is, of all countries, the most inviting to these foremen of the world's industries and leaders of the progress of civilization.

The leadership of the white race among the races of men will always find the renewal of its power in the valley of the Mississippi. It will be from the valley of the Mississippi and its affluents that this leadership will always come, with ample and unfailing power to "multiply and replenish the earth" in coming ages; and it is the noblest work of this generation to lay, broad and deep, the foundations of this industrial progress.

It is especially the work of the United States, and of the States included in the watershed of the Mississippi River along the coast line of the Gulf of Mexico, to contribute all necessary aid and encouragement to its permanent and scientific development. As an encouragement to such efforts it is now seen that, with small expenditures and slight and unsteady work, the Mississippi Valley and its water courses already supply to external and internal commerce more of wealth than the Nile or the Danube, or the Rhine or the Rhone, or the Indus, or any other river system in the world.

Those water courses of the Eastern Hemisphere, with a fertility of soil that has always sustained vast swarms of people, and with inhabitants whose monuments in architecture, viaducts, sea walls, and dikes, and whose paintings, sculptures, and monuments are still numbered among the highest of human achievements, are outstripped in the progress of the highest and best civilization by our labors in the valley of the Mississippi; and this is the work of a pioneer population, almost without help from any government.

ISTHMIAN CANAL.

Such results are only a feeble forecast of those that yet await our intelligent and systematic labors.

This general survey of the importance of the basin of the Mississippi River, in respect of the industrial, commercial, and military power of the United States and in shaping and controlling the future progress of the highest civilization throughout the world, brings to view a great national duty that is becoming still more imperative through the opening of a ship canal through the isthmian region of America.

This work will be equivalent to opening a new mouth for the Mississippi River into the Pacific Ocean.

The mere statement of this fact, now in process of accomplishment, presents with irresistible force the national demand for thorough, prompt, active, and scientific work in preparing the Mississippi River and its navigable affluents for conveying to the uttermost parts of the earth the rich stores of commerce now locked up in this vast region.

But aside from all questions relating to foreign commerce and to our power among other nations, the internal commerce and home

trade of this region give it a paramount importance in its influence upon the growth and strength and power of the United States in all civil, industrial, and military operations, to which the attention of Congress is now respectfully invited by the committee.

We again appeal to the fact that if the United States are to assume their just rank as a leading world power, we will only measure up to that standard by using our resources in making this the greatest home power in the world; and that is the splendid destiny whose foundations are established in our form of government, in our Constitution, and in the hearts of our people.

THE PECULIAR LOCAL VALUE OF THE MISSISSIPPI BASIN AND ITS NAVIGABLE WATERS TO THE UNITED STATES AS AN ELEMENT OF INDUSTRIAL, COMMERCIAL, AND MILITARY POWER.

The Great Lakes bound the basin of the Mississippi on the north, and cover that part of the watershed extending from the central river to the Appalachian range of mountains.

On this frontier there is a depression that extends from Pittsburg on the Ohio River, through which a ship canal will connect the Lakes with that river as a military necessity and as a channel of commerce.

Chicago has opened the drainage canal from Lake Michigan to the Illinois River as a matter of local necessity. That channel will never be closed, but it will be extended and enlarged to admit of navigation by seagoing vessels.

These connections of the watershed of the Lakes west of Buffalo with that of the Mississippi River will combine them into one grand system of navigation for the uses and purposes of commerce that will reach the ocean through the mouth of the Mississippi River and the Bay of Mobile instead of the mouth of the St. Lawrence River.

Other inviting possibilities exist and are already presented in elaborate reports of United States Engineers for connecting the waters of the Tennessee and Alabama rivers.

Such opportunities in France, Holland, Belgium, and Germany, on a much smaller scale, have been seized upon by those Governments and have been improved at a great cost, until their small canals have become an indispensable part of the industrial, commercial, and military power of those countries. Some day we will profit by their example.

INTERCOASTAL LINE OF NAVIGATION.

We are at the beginning of the improvement of our great internal system of navigation, and the greatest care is needed to establish its proper adjustment, so that its usefulness shall keep pace with the growth of the country, and its results shall be one of the chief glories of the Republic.

The connection of the valley of the Mississippi through the Lakes, and through the great river that carries all its waters to the Gulf, are certain events of the not distant future, that will open lines of intercommunicating navigation between every river as far west as the Rocky Mountains and every seaport of the Atlantic from the mouth of the St. Lawrence to the Rio Grande.

In this connection it would be a narrow forecast of the future commercial power of the United States and their military security to omit from our calculations the importance of the intercoastal waters that will furnish interior connections of safe and convenient naviga-

tion that will connect the mouths of every navigable river of the United States that empties into the ocean on the Atlantic coast.

Such is the configuration of the coasts of the Atlantic and the Gulf of Mexico and of the interior waters that are distributed along the entire length of this wonderful system that it is our good fortune to be able, at a low cost, to give an interior mouth, in addition to its present exit to the ocean, to every navigable river between Cape Cod and Florida, and between Florida and the Rio Grande; and thus to connect all these water courses by means of ship canals that will be safe from invasion by any foreign power and from the dangers of ocean navigation.

In these channels, now almost completed by the hand of nature, it will be found that our naval defenses will be strengthened by war vessels of light draft, that will enable us to dispense with many great ships of war that would otherwise be necessary even for coast defenses or to preserve a sea power that would equal, if it will not dominate, that of the greatest maritime powers.

This is not a remote or fanciful conjecture of events that are very far distant. In various places along the Atlantic and Gulf coasts these advantages are calling forth the active work of the people of our eastern maritime States, and they are demanding that the Government will enter upon the construction of this intercoastal line of defenses and of commercial intercourse along the great coast line of the Atlantic and the Gulf of Mexico.

A powerful local organization is earnestly at work to connect Victoria, Tex., with New Orleans by an intercoastal canal, and the facts that require the extension of this route to the bays of Mobile and Pensacola are far too important to be long neglected. Appendix C is a map of the Texas project, with a condensed statement of the leading feature of the route.

OUR PHENOMENAL PROGRESS.

It is surprising and most encouraging to those who measure the strength and glory of the United States as a world power by the standard of our strength as a home power to contemplate the rapid advance we are making in the development of all the vast resources of national strength that are so abundant within our limits.

Among these resources none are more valuable than the navigable water courses of the great interior country drained by the Mississippi. When these rivers are so connected by intercoastal canals that the navigation of any of them will be common to all the people the United States will be the greatest power in the world, because its home power will excel that of all the other world powers.

IV.

A NEARER VIEW OF THIS SUBJECT.

If the proper discussion of this subject in connection with the Mississippi basin requires narrower treatment to suit the present demands of duty there is a nearer view that is so impressive as to demand the careful consideration of Congress.

The approximate length of navigable waters of the Mississippi and its affluents as they are at present so designated by the Government is 13,261 miles.

Each river has what is now termed a "head of navigation," and along its shores it has cities, towns, villages, or landings, each of which is a mart convenient of trade and commerce. These places may be numbered by thousands. In the aggregate they comprise commercial and industrial centers of enormous wealth. Their increase is so rapid that an approximate statement of their wealth at present would fall very far below the real volume of wealth a year hence.

CENTRAL BAY OF THE VALLEY OF THE MISSISSIPPI.

No nation in the world has so grand an aggregate of internal commerce as is produced in the Mississippi Valley and is interchanged in commerce that is exclusively domestic, and no watershed of any river in the world contributes from its native productions such vast and valuable material to foreign commerce. And this is but the beginning of our work for the people of the earth. The Missouri, coming from the west, and the Ohio, coming from the east, enter the Mississippi within a distance of 150 miles from each other. This meeting of great waters is at points that are about midway the length of the Mississippi River.

The mouth of the Ohio, at Cairo, is at the southern line of the geological system that forms the more permanent banks of the Mississippi to its source. Below that base the Mississippi River forms its own banks, through an alluvial plain that has an average width of many miles, not less, it is supposed, than 100 miles.

On this short reach of the Mississippi the cities of St. Louis and Cairo are the leading commercial marts, separated by a distance of less than 100 miles.

This short section of the Mississippi River is near the center of its vast watershed, considered with reference to its commercial geography and its line of navigable waters.

About 90 per cent of the entire commerce of the Mississippi River, between the various heads of navigation and its mouth, must pass through this short channel of about 150 miles, situated in the economic center of this vast catch-basin. This central estuary is beyond question the most important commercial point in the interior of the United States.

There is no seaport of the United States that, at this time or in the future, can be more important to our domestic and foreign commerce, and there is none that has higher claims upon the consideration of Congress.

Into this central estuary rivers to the east and the west and to the north and south bear their vast burdens of commercial wealth, not merely to deposit them for sale or consumption at important points of distribution, but, at the option of the owner, to continue their journey to the sea or to any of the vast number of ports or places on the waters of this grand system and of other water courses where he may choose, to find a market for his productions or his trade.

ITS RIGHTFUL DEMAND OF THE CARE OF CONGRESS.

This great interior bay, 150 miles long on the Mississippi and 40 miles on the Ohio, is equally convenient and useful to those who wish to purchase or sell articles of commerce in the cities that are located

upon it and to those who wish to find such a market on any of the rivers that flow into the Mississippi.

This is a common center of all the commerce of the entire watershed of the Mississippi and its population, already vast, and for this river and the affluents that form it and contribute to its trade, the claim is firmly made that it deserves the care of Congress equally, at least, with any bay or harbor on any of our seacoasts. Added to this and forming a part of it is the bay of deep water, 40 miles long, reaching from Cairo to Paducah, formed by the Ohio and the Tennessee—the great twin rivers whose headwaters are in the Appalachian range of mountains.

The rivers that come from the west into the Mississippi represent the commerce of a region that is comparatively new, in which the highest ranges of industrial enterprise, supported by men of great energy and of the best abilities, are rapidly producing results that stand in the forefront of the social, industrial, and financial progress of the people of the United States.

No region of our country has a better assured place in the leadership of a high civilization than that lying to the west of the Mississippi River. The future domestic commerce between the people of the Mississippi Valley to the east and west of that river will be interdependent and valuable in the highest degree, and whatever may increase the facilities of commerce on either side of that river will be of great benefit to the people of the other side. Their interests are in common and in perfect harmony.

Nothing can more rapidly or permanently develop the country in the foothills of the Rocky Mountains and in the plains that border the Mississippi and Missouri rivers than free access to the forests east of the Mississippi River through water transportation. It is not beyond reasonable calculation that the interchange of fertilizing soils and minerals between these regions will enter into agricultural pursuits, to the great advantage of the whole country.

EASTERN DIVISION OF BASIN OF THE MISSISSIPPI.

The eastern division of the watershed of the Mississippi River is the field of inquiry that concerns more immediately the duties of this committee.

Within that division two catch-basins cover the entire area that contributes to the commerce of the Mississippi north of Memphis and south of the Illinois. That of the Illinois River stands apart as a separate system, while that of the Ohio includes the Tennessee, the Cumberland, the rivers of Kentucky, and a large part of those of West Virginia, for the reason that no high elevations separate the larger portions of their watersheds.

Through the Ohio River, from Paducah to Cairo, a distance of 42 miles, all the waters of these several catch-basins flow to the Mississippi.

DOUBLE ESTUARY OF THE CENTER.

This is a second bay, or estuary, that is common to an immense region, and all its navigable affluents are entitled to the earnest and just consideration of Congress.

The committee can not omit to call special attention to this double bay, or estuary, in the center of the eastern grand division of this continent, of which the Rocky Mountain range is the line of geographical demarcation.

This estuary points to the northwest from Cairo, and is at the meeting of the waters that rise in the Rocky Mountains. It also points to the east and northeast from Cairo, and is at the meeting of the waters that rise in the Appalachian range.

The Mississippi River, which rises in the region of the Great Lakes, almost equidistant from these great mountain ranges, flows to the south in a course that is nearly central between them, and passes through the great central bay above described on to the Gulf of Mexico by the nearest line, which it is always seeking to establish.

Below Cairo it has few great affluents, and is so unlike other rivers of this hemisphere in its unstable banks and great erosions that scientists, geographers, and some great statesmen insist that it is an arm of the sea that has been changed to a river by the washings from the mountain streams. However this may be, the process of building channels into the Gulf of Mexico is going on rapidly.

Treating the Mississippi from Cairo to the Gulf as an arm of the sea is just and logical, and it involves such treatment as we give to seaports in favor of the waters that form the great double estuary that reaches around the angle between the mouths of the Illinois and Missouri rivers and the former mouth of the Mississippi to Paducah, at the junction of the Ohio, the Cumberland, and the Tennessee rivers.

TRUE QUESTION OF PUBLIC DUTY.

The question of governmental duty that arises out of this wonderful concentration of great navigable water courses in the center of the valley of the Mississippi is the same as if Cairo was still connected with the Gulf of Mexico by an arm of the sea, through which the tides ebb and flow. It is more important, because the Mississippi and its tributaries below Cairo have builded along its course a delta that is more fertile than any region in the world and is larger than the delta of the Nile or the Amazon or the Yellow River of China.

PUBLIC DUTY AS TO TRIBUTARIES OF THE MISSISSIPPI.

The committee will limit its inquiry on this point to the water courses that unite at Paducah, all of them having a common channel from Paducah to Cairo.

There is a comparative duty, regulated by varying conditions, as to the progress of the improvements that should be made from time to time on the several water courses that unite finally with the Mississippi at and above Cairo.

The navigable length of these rivers and the commerce that is now and will hereafter be transported on them are factors of prime importance in making appropriations for the improvement of their navigation.

The following list is a close approximation, based on Government surveys, of the navigable length of the rivers that unite with the Mississippi as the same is adopted in the reports of Government engineers:

Navigable length of rivers in Mississippi Valley.

	Miles.		Miles.
Mississippi River.....	2,189	Cumberland River.....	518
Missouri River.....	2,513	Wabash River.....	104
Arkansas River.....	768	Green River system.....	176
Red River.....	647	Kentucky River.....	261
Ohio River.....	967	Licking River.....	10
White River.....	324	Big Sandy River system.....	191
Ouachita system.....	935	Guyandot River.....	119
Yazoo River.....	235	Great Kanawha River.....	90
Sunflower River.....	144	Little Kanawha River.....	50
Tallahatchie River.....	105	Muskingum River.....	84
Current River.....	80	Allegheny River.....	126
Cache River.....	72	Monongahela River.....	131
Black River.....	146	Tennessee River.....	652
St. Francis River.....	310	French Broad River.....	70
Ohlou River.....	50	Clinch River.....	75
Forked Deer River.....	33	Hiwassee River.....	42
Osage River.....	45	Holston River.....	50
Gasconade River.....	79	Little Tennessee River.....	40
Illinois River.....	135		
Rock River.....	20	Total.....	13,261

If all these lines of river navigation were substituted or paralleled by first-class railroads belonging to corporations, and if great trunk lines were constructed to carry the commerce and travel between St. Louis or Cairo and the mouth of the Mississippi and were confined by laws to the lowest possible rates, it would be seen at a glance that the river transportation could not be given up in justice to the people, because it would be the cheapest and the most useful.

There is one paramount reason, that can never be changed, to support water transportation against all other methods. It is, that the navigable waters belong to the people and cost nothing for construction, while all other methods belong to individuals or corporations, and the cost of transportation must be calculated at a profit on the cost of construction and ownership. A great share of this profit is saved to the people in their right to use freely and without charge all the navigable waters of the United States.

SUBSIDIES TO RAILROADS AND NEGLECT OF THE WATER COURSES.

The States, almost without exception, and the Government of the United States have granted subsidies to railroads in lands, rights of way, timber, stone, minerals, and water, and in money, bonds, and debentures, to an extent that almost defies computation at their present value. Added to this are exemptions from the payment of interest and taxes, and privileges as to tolls and charges that are claimed to have grown into vested rights, which are also of inestimable value.

Conceding that the country has prospered under this system of general subvention, it must also be conceded that the cost of it to our industries has reached a point where they are only permitted to exist at the will and pleasure of the railroads, or to subserve their interests. But, passing this by as a matter that may be properly omitted from this discussion, the question remains, What has been done for the people by these governments in the improvement of the navigable waters that belong to them? The answer is that, by a just comparison, nothing has been done for the people.

Congress, in balancing the demands of duty in respect of the all-important interests of transportation, must find that a tremendous deficiency of legislative provisions in the bills of appropriation has been visited upon the people by an unjust and unwise discrimination against our navigable waters. Their money and property have been taken to build up and to foster lines of railroad, while the water courses that belong to them have either been entirely neglected or appropriations for improving them or to prevent them from being destroyed have been fitful, wasteful, grudging, and wholly insufficient, until a river and harbor bill in Congress is always a beggar of public alms and is often the subject of derision and contempt on the part of those who give, without stint, the public funds and property to great railroad corporations and their vicious trusts and combines.

TWIN RIVERS—THE OHIO AND THE TENNESSEE.

Geographically and commercially, as well as in respect of the geological identity of their watersheds, the Cumberland and the Tennessee rivers should be considered as one system of navigable waters.

They rise in the same mountain range and in close proximity; their upper tributaries flow from the same coal and iron fields and through the same vast forests. In their westward course they diverge, the general course of the Cumberland being to the south of west, while the course of the Tennessee is nearly south, through East Tennessee, until it breaks through Waldens Ridge, at Chattanooga, a distance of 188 miles from Knoxville. Then it flows west for a distance of 230 miles, through Alabama to Riverton, where it enters a great valley known as West Tennessee, and runs nearly due north and parallel to the Mississippi for a distance of 226 miles to its junction with the Ohio. The Cumberland River enters the same great valley near Nashville, and traverses it on a course near to and parallel with the Tennessee for a distance of about — miles, and enters the Ohio, at a point about 12 miles above the mouth of the Tennessee, at Paducah. In the circuit of their courses these rivers inclose the richest areas of East Tennessee, middle Tennessee, and north Alabama to the east, and of Mississippi on the west, in two great parallelograms, which they nearly inclose on four sides. One of these great unbroken areas covers the entire watersheds of the Cumberland and Tennessee rivers east of Paducah. The other is inclosed on three sides by the Tennessee, the Ohio, and the Mississippi rivers.

It is difficult to give to either of these rivers—the Cumberland and the Tennessee—full justice in respect of the care due to them from the Government, without recognizing and respecting the fact that their resources of wealth and commerce, like their geography and geology, are almost identical. Taken together, these rivers and their watersheds present a feature that is so anomalous and so grand as to deserve special consideration.

There is no part of the world that has greater or more varied wealth of industrial resources than the great parallelograms included in the watersheds of these rivers of Tennessee, Alabama, and Kentucky. It includes the great mineral and agricultural region, with its splendid forests, between the watershed of the Ohio on the north, and of the Alabama, Savannah, and Chattahoochee on the south.

It is a country that stands apart from other regions as possessing within its own limits all the staple material that is necessary to the highest development in agriculture, forestry, minerals, water power, and steam power. Tennessee River, in connection with the Cumberland, is longer than the Ohio from their respective heads of navigation to Paducah, where they unite, and serves a purpose of commercial advantage that no other river in the United States affords.

This is a just treatment of the subject, for reasons already stated, and for the more important reason that the division line between the watersheds of Cumberland and Tennessee rivers from their headwaters in the same mountains to Mississippi River is marked by a range of low hills, across which railroad lines are constructed at a low cost and will be very numerous as competitors for the transportation that will be demanded by this vast region, filled with stores of native wealth.

In the improvement of all our interior rivers their power to control the cost of transportation is the factor of paramount importance, and Ohio River, owing to the configuration of its watershed, does not afford so controlling an influence over the cost of railroad transportation as Cumberland and Tennessee rivers.

The Ohio watershed is long and narrow and, taking Paducah or Cairo as the point of destination for the heavy products of the commerce floated on Ohio River, the distance to the mines and forests, and to the richer fields of agriculture tributary to the Ohio, is much greater than it is to those that supply commerce to the Cumberland and the Tennessee.

Cumberland River, rising in the western slope of the Allegheny Mountains, has an almost direct course to the Mississippi; while the Tennessee has its principal source in the eastern slope of those mountains, and its headwaters are assembled in the prolongation of the great valley of Virginia.

The mouth of Tennessee River, at Paducah, is farther to the north than Knoxville, its present head of navigation; so that its general course in two of its longest reaches parallels the Mississippi, and in its western reach it runs in the opposite direction. In its general course it runs from the south to north, while the Mississippi runs from north to south.

This gives to all the region in the watershed of the Ohio a line of navigation into the South that is east of the Mississippi and is independent of it.

As this line of navigation reaches to North Carolina, Georgia, and Alabama, and passes nearly across East Tennessee and quite across West Tennessee and into Kentucky, its importance to the commerce of the country along the Ohio can scarcely be exaggerated.

Tennessee River is so located, geographically, as to gather the transportation of commerce from the valley of Virginia, from western North Carolina and northern Georgia, from eastern Tennessee and northern Alabama, from northern Mississippi and West Tennessee, and bear it northward into Kentucky. No other river in the United States has a course along which such vast and inexhaustible resources of industrial and commercial wealth are stored, or that can bear them northward to the great bays that reach from Paducah to Illinois River.

V.

TENNESSEE RIVER AND ITS AFFLUENTS.

For the purposes of this report this river will be considered as being navigable from Knoxville to Paducah, those being the points between which the Government has projected and, in some degree, has accomplished plans of improvement. The length of this part of the river is 653 miles. The altitude above sea level at Knoxville of the river surface at low water is 792 feet and at Paducah it is 278 feet. This gives to the river an average fall of seventy-nine one-hundredths of a foot per mile.

BANKS OF THE TENNESSEE.

The course of the river in its entire length is through a soil that is chiefly clay, and there is no considerable part of its banks that are subject to erosion, even in the most excessive floods.

With reference to obstructions caused by the washing of its banks, or the deposit of silt, sand, or gravel, it may be said that in an engineering sense, and as to deposits from erosion, caving, or floods, that neither Tennessee River nor any of its affluents have caused or are likely to create any ground of apprehension as to its future serious obstruction at any point.

It is only at Knoxville and Chattanooga that Tennessee River has for its banks the base of any high elevations that might be designated as mountains, and these are for short distances.

It is probably true that no river in the United States is more convenient of access to the people with wagons and teams, or better suited for the use of the water power it affords along its banks and in localities that are healthful and attractive for homesteads. The water power of Tennessee River and its affluents is a very important part of its advantages, especially in many and varied manufacturing industries and in the future increase of the commerce of the river, which will be specially considered in a separate part of this report.

GEOGRAPHY OF THE TENNESSEE RIVER.

In the brief discussion of the watersheds of Cumberland and Tennessee rivers, and their practical identity in commercial productions and in their transportation lines, some allusion has been made to the remarkable geography of Tennessee River.

This feature of the subject is a matter of such an extraordinary value to the United States that the committee should not fail to present, at least in outline, its elements of the wealth and the opportunity it furnishes to such numbers of our people to send them afloat upon its waters as active commerce. The first course of Tennessee River is to the south-southwest from Knoxville to Chattanooga, a distance of 188 miles.

The principal affluents of the Tennessee in this section are the Holston, which has its principal sources in the mountains that flank the great valley of Virginia on either side as far north as the watershed of the rivers of West Virginia; and the French Broad, the Clinch, the Little Tennessee, and the Hiwassee.

HOLSTON RIVER AND THE RAILROADS.

The improvement of the navigation of the Holston is left out of this discussion for the future separate examination that it will bring out as a competitor with railroads in the valley of Virginia.

If Tennessee River had even a 6-foot channel from Knoxville to Chattanooga those railroads could make better profit in hauling the heavier productions of the Holston Valley to Knoxville, the nearest point of water navigation, than they could possibly realize by hauling them to New Orleans, or Memphis, or St. Louis, or Pittsburg, or Cincinnati, or Chicago, the reason being that such productions, even those as light as corn, wheat, potatoes, hay, etc., will not bear the railroad freight rates for such long distances in competition with more favored fields of production, while coal, iron, stone, timber, and the ores of copper, zinc, lead, and many other valuable productions are driven from the markets at home and abroad by the cost of railroad transportation.

What is true of the valley of the Holston is true of the valleys of the French Broad and of the Clinch, the Hiawasee, the Little Tennessee, and of every river between Knoxville and Chattanooga that flows into the Tennessee.

When an estimate based on known facts and conditions is made as to the values that are now paralyzed or rendered useless for the want of river transportation on Tennessee and Cumberland rivers, our country will suffer a reproach that is little short of the willful destruction of its richest and most enduring treasures of wealth, by its neglect to improve their navigation.

GEOGRAPHICAL DIVISIONS OF TENNESSEE RIVER.

The proper divisions are the eastern, extending from the mountain sources to Chattanooga; the central, from Chattanooga to Florence, Ala.; and the western, extending northward from that point through a part of Alabama and Mississippi and through west Tennessee and southwest Kentucky to join the Ohio River at Paducah.

The ultimate destination of the commerce collected along these three divisions of Tennessee River, each running in a different direction, is generally assumed as being the Gulf of Mexico, through the lower Mississippi. But a far more important point in its concentration and distribution, as it concerns the welfare of the people of the United States, is at the bays and estuaries in the center of the watershed of the Mississippi River that reaches around from Paducah to Illinois River.

The three great and distinct areas that supply this commerce, each making a contribution to its volume that is drawn from the country through which each division of the river flows, is within itself equal to that of other water courses of several times its length in other regions within the watershed of Mississippi River.

In respect of the concentration of the commerce produced in each of its geographical divisions and drawn from the country through which it flows, Tennessee River has no rival within the watershed of the Mississippi.

EASTERN DIVISION.

The eastern division has its origin in the Blue Ridge range of mountains and the eastern slope of the Alleghenies, in water courses that meet in the great valley of Virginia. This valley extends through East Tennessee, northwestern Alabama, as far south as Coosa County, and northern Georgia, where it ends by contact with a different geological system—the metamorphic or granitic system—which extends into the Carolinas. It also meets the Coal Measures that extend, on the western side of the Coosa River (which is within the watershed of the Alabama River), in a northeasterly direction across Tennessee River at Chattanooga, and across the States of Tennessee, Kentucky, West Virginia, Virginia, and Maryland, into Pennsylvania.

Some force of nature from the direction of the Blue Ridge or Smoky Mountain range, pressing toward the great depression of the Mississippi River, seems to have caused Tennessee River to break through the cordon of these Coal Measures at Chattanooga, thus changing its course suddenly to the west.

This abrupt change of direction of Tennessee River left a long reach of the valley of Virginia, between Hiawassee River and the watersheds of the Alabama, the Chattahoochee, and the Savannah rivers, nearly as far to the south as Atlanta, Ga., without water transportation to the Gulf of Mexico.

A very large and rich area of country, extending eastward to the Smoky Mountains, or Blue Ridge, and southward to the watershed of these rivers, was made tributary, as to water transportation, to Tennessee River on its westward course and practically concentrated at Chattanooga, so that, in considering the rights of the people and the duty of the Government in giving preference to navigable water courses over all other systems of transportation, in the necessary anticipation of the coming time when the water courses will be the primary system of transportation, to which all others will be subsidiary, this rich area of the valley of Virginia and its flanking mountains, stored with coal and iron, will find enormous advantage in concentrating its heavy commercial material for transportation on Tennessee River at and above Chattanooga.

CENTRAL DIVISION.

From Chattanooga, where Tennessee River breaks through Waldens Ridge, which is an extension of the Allegheny Mountains, to Alabama, Tennessee River curves to the south, in a course nearly parallel with the extension of Waldens Ridge, westward, which is there known as the Sand Mountain Range. All of this range of mountains is superimposed upon Coal Measures that demark its boundaries.

This great curve of Tennessee River reaches as far to the south as Guntersville, Ala., which is 105 miles from Chattanooga, measured by the river channel, and is 36 miles south of Chattanooga. Thence it flows through Alabama, on a course that is nearly west, to Florence, and thence to the northeastern boundary of the State of Mississippi.

On the northern side of the central division the Tennessee River

receives through Sequatchee Valley, chiefly, the coal, iron, and timber that comes from the western slope of the Alleghenies and the spur ridges into which it is divided as far north as the Cumberland watershed.

This and other valleys leading to Tennessee River and extending to southeastern Kentucky are capable of supplying incalculable quantities of coal, iron, and timber for transportation in that river, which is the only water route accessible to them, at a cost that will justify their development.

In the southern counties of Tennessee there are extensive deposits of phosphates and of iron ores, that are of great value.

On the southern side of this central division the Coal Measures that form the northern watershed of the Alabama River are within a distance of from 5 to 50 miles of Tennessee River in its entire extent through Alabama and a part of northwestern Georgia.

Within a distance of 50 miles from the river the vast beds of coal and iron along the northern slope of Sand Mountain, with an elevation of about 700 feet, are easily accessible to its transportation. If this was the only route of transportation for coal and iron from the Sand Mountain coal and iron deposits, known as the "Birmingham district," to the Gulf of Mexico, that district would still be more important to the world than the coal mines of Wales and the iron mines of Sweden.

The transportation of the coal and iron products that are in easy reach of Tennessee River to the Gulf of Mexico and along the shortest lines to the western watershed of the Mississippi would make the eastern and central sections of Tennessee River the most important body of water in the world, as to commerce in coal and iron.

If there was no other commerce on these two sections of Tennessee River besides coal and iron and their products, the United States would have a greater material interest in the improvement of their navigation than they had in the connection of the Atlantic and the Pacific oceans by the grants, subsidies, loans, and privileges accorded to the Union and Central Pacific railroads.

The benefits of this transportation on Tennessee River are greater in money value, more permanent and more useful to the people of the United States, and more indispensable to their progress in all industries, and in all the necessities of national strength, than this great transcontinental line.

When the other elements of commercial wealth are taken into consideration, the eastern and central divisions of Tennessee River far excel the Union and Central Pacific railroads, as contributors to the wealth, power, convenience, and permanent growth of the United States.

WESTERN DIVISION.

Beginning at Florence and passing through the northeastern corner of the State of Mississippi, Tennessee River turns abruptly to the north, in its flow to join the Ohio at Paducah, a distance of 226 miles. It again passes across the State of Tennessee, and penetrates Kentucky far to the north, nearly on a line east and west with the head of navigation of the Kanawha River in West Virginia. It reaches a line, northward, that is the real southern base line of the navigation of the Ohio River. It thus forms three sides of a grand quadrangle,

of which the Ohio and the Kanawha form the fourth, which wants only about 125 miles of being closed in a complete circuit of navigable waters.

It may be safely left to American enterprise and the presence of commercial necessity, to square this great circle, by a system of canalization that will connect the Kanawha, through the valley of Virginia, with the Holston or with Clinch River. When that is accomplished, we can compare notes with the French, the Belgians, the Hollanders, and the Germans, as to works of useful internal improvement, without suffering national reproach.

But the present importance of the western section of the Tennessee River does not depend upon any further development of national advantages or necessities. They crowd upon us now with a present pressure of necessity, and the inducement of profit to the people, that is irresistible.

A marvelous and inscrutable force of nature diverted the waters of the Tennessee after they had broken through the Coal Measures at Chattanooga on a headlong course to the basin of the Mississippi, squarely to the north to join the Ohio. The Tennessee, thus running in a course directly opposite to that of the Mississippi for a distance of 226 miles, is east of the Mississippi at an average distance of 75 miles. For 50 miles Cumberland River runs north alongside the Tennessee at an average distance of 10 miles.

The waters of the Tennessee at Riverton travel 226 miles to reach the same latitude as that of the Mississippi at Cairo, while a barrier of only 75 miles on an average separates them. These conditions need not now be discussed, except in the view that they force the vast commerce of the Tennessee and the Cumberland on a shorter water line to Pittsburg and to Chicago by the distance of 266 miles and away from New Orleans by a distance of about 500 miles.

Florence is about 500 miles nearer to Pittsburg and Chicago by water routes than it is to New Orleans.

These conditions are now in sharp discussion between competing railroad companies. They show the great interest the Ohio River and the Lakes have in the improvement of the navigation of Tennessee River.

The western division of Tennessee River has a commerce that grows upon its banks which would make it one of the most important water courses in the United States. It has no mines or minerals of extraordinary importance, but its forests of timber, its vast productions of cereals, grapes, and fruits, added to its exceptional importance in the production of cotton, make it a great center where all mineral wealth of the central and eastern divisions and all of the wealth of the three great divisions in grain, forage, timber, animal and dairy products, cotton, wool, and of the arts and manufactures that enter into commerce, domestic or foreign, will be collected for distribution or will pass through to the markets of the world.

Along this western division is the northernmost reach of our cotton fields, which, in their most fruitful yield, extend over all the country of the great cotton belt that begins at the James River, Virginia, and reaches to the western borders of Texas and Oklahoma.

All three of the divisions of Tennessee River are included in this cotton belt, from Knoxville to Paducah, and furnish this indis-

pensable textile to all the eastern watershed of the Mississippi at the cheapest cost for transportation.

It does not seem possible that Congress can be indifferent to the improvement of the navigation of this river that belongs to the people, because the wealth of their lands still enables them to bear the heavy burden of taxation in the form of railroad freights, which they must pay to their owners. There is no just reason why this burden should not be reduced.

The Ohio and Tennessee rivers west of the Alleghenies, with the shorter rivers that rise in those mountains or their foothills and flow between them to meet the Mississippi, encompass the largest, the most productive, and the most salubrious and beautiful upland region of country in the world.

None of these rivers are competitors with each other for the transportation of commerce or with any other system of navigable waters. Each of them is of material assistance to all the rest in distributing the wealth of every form of commerce, and no improvement of the navigation of either of them can be made that is not a benefit to all the rest. The man who works in Montana is as sensibly, if not as directly, benefited by the improvement of the navigation of the Tennessee or the Ohio River as the man who works in Knoxville, Pittsburgh, or Monongahela.

TENNESSEE RIVER.

ENGINEERS' STATEMENTS AND OPINIONS.

The main stem of the Tennessee River is 653 miles long. It is formed by the junction of French Broad and Holston rivers, 4½ miles above Knoxville, Tenn., 188 miles above Chattanooga, Tenn., and flows into Ohio River at Paducah, 464 miles below Chattanooga. Together with its principal tributaries, it forms a system of internal waterways capable of being navigated more than 1,300 miles by steamboats. In addition to this, its tributaries are still farther navigable by rafts and flatboats for a distance of more than 1,000 miles, thus making a system of internal navigable waterways of over 2,400 miles in length, with a drainage area of about 44,000 square miles.

Its low-water discharge at Knoxville, Tenn., is over 3,500 cubic feet per second; at Chattanooga, 8,000 cubic feet per second, and at Paducah, where it joins the Ohio River, over 10,000 cubic feet per second.

There has been appropriated for the Tennessee River, up to June 30, 1905, a total of \$7,170,366.75, of which amount \$913,418.50 has been allotted for maintenance and operation of Muscle Shoals Canal.

The total amount expended on this river up to June 30, 1905, is \$5,515,241.19, which includes the cost of building the Muscle Shoals and Elk River Shoals canals. But it does not include the cost of the maintenance of the Muscle Shoals Canal.

The following extracts from the reports of the Chief of Engineers show the importance of this river, and the estimates thereof by various chiefs of engineers and officers in charge:

Report of 1884:

From Chattanooga to Knoxville the river is navigable the greater part of the year. The obstructions consist of occasional gravel bars, rock reefs, rapids

shoals. Regimen of river is practically permanent, practically little change in fifty years; and as the rock excavations, stone dams, etc., are but little affected by the elements, any improvement once made is practically permanent. The annual appropriations for several years past have been so small that but little work could be done, and the cost of what has been done has, for the same reason, been greater than it should have been.

Because of the smallness of annual appropriations, mainly, it will be impossible to complete all the work that should have been done on this stream within the modified estimates, and as the work is of great importance, I recommend that estimates be increased.

Report of 1887:

The Tennessee is now considered as formed by the junction of the waters of the Holston and the French Broad, $4\frac{1}{2}$ miles above Knoxville, and is one of the most important tributaries of the Mississippi River. The opening of this river, by means of a canal around Muscle Shoals, was favorably considered by the General Government before any action was taken in the matter.

In many instances greatly reduced freight rates have been obtained because of the opening of the channel at the upper entrance to the Elk River Shoals Canal. The prospective advantages to navigation, as well as the benefits to the community, of opening the entire stream below Chattanooga are considered by the inhabitants of the Tennessee Valley to be well-nigh incalculable.

The whole region is rapidly developing as one of the richest in coal, iron, and other minerals; all that seems necessary to the further development of these resources is cheap transportation and an open river to the commercial centers of the Mississippi Valley.

Report for 1888:

The prospective advantages to navigation, as well as benefits to the community, are the securing a better channel for a longer season, which, because of improving of its largest tributaries—French Broad and Clinch—will extend to Leadvale on former 90 miles, and to Clinton 70, on latter; in addition, will give practical enjoyment of commercial advantages, resulting from a navigable lower river, to the great western waters by the completion of Muscle Shoals Canal to the commerce of the Mississippi River.

The whole region is fast developing as one of the richest in coal, in iron, and in other mineral deposits; and all that seems necessary to the further development of the unquestioned resources is cheap transportation and an open river to the commercial centers of the Mississippi Valley.

Delays in getting funds result in loss of whole working season, which, combined with the disorganization of the working forces, render it difficult to resume operations.

Report for 1889: Gen. T. L. Casey, Chief of Engineers, says:

The bed and banks of the river are only subject to slight changes; improvements when made are therefore practically permanent.

A lengthened season of navigation has been secured for steamboats and an improved channel for rafts and flatboats, which necessarily constitute the larger part of the upper Tennessee. The commerce is growing rapidly. The prospective demands of same will require before many years a new project, with revised estimates, having in view a radical improvement of its upper waters, resultant upon the opening of a navigable lower river to the Mississippi system, by opening of Muscle Shoals Canal, and by the improvement of its copious upper-river tributaries.

The recommendation of a liberal appropriation is renewed urgently, so that the work may be commenced at the earliest possible moment, and continued to completion as rapidly as possible.

An improved river from Knoxville to Paducah will cause Tennessee River to take rank among the foremost of the tributaries of the Mississippi.

The conditions named in last year's report apply in an increased degree to present conditions, which predict a prospective commerce of vast magnitude, in coal and iron especially, to an extent by which this river may rightfully claim to be one of the main commercial arteries of our vast and intimately connected systems of southern and western waters.

Report for 1890: Gen. Thomas L. Casey, Chief of Engineers, states:

The banks are of such a character as to make any improvement practically permanent.

Colonel Barlow, officer in charge, says:

Nowhere in the United States has the growth been more marked and rapid than in the country bordering on Tennessee River. The opening to a limited extent of the vast mineral interests of this section has given a wonderful impetus to this growth, and has, by giving increased confidence to those already engaged in new enterprises, attracted the attention of those seeking new investments for idle capital elsewhere. The inhabitants are watching with eager interest the progress of the improvements on the river, realizing that the benefits accruing from an open river, navigable throughout the year, will be well-nigh incalculable.

Cheap transportation and an open river to the commercial centers of the country and the Mississippi Valley is believed by all to be all that is needed to insure the growth of the commerce of Tennessee River, that will soon make it one of the main arteries of our vast and intimately connected systems of southern and western waters.

Report for 1891: Gen. Thomas L. Casey, Chief of Engineers, states:

The radical improvement of the Tennessee River, so as to make navigation continuous for boats of moderate draft, is by no means an impossibility.

A board of engineers states:

The finishing of a lateral canal at Colbert Shoals, together with the improvement at Muscle Shoals, will largely increase the commerce of the river. We recommend large locks and canals, as large as on Mississippi River, because commerce will certainly require it. During the past fifteen years the lower part of the river has not received the attention it deserves.

Report for 1892: Lieutenant-Colonel Barlow, engineer in charge, states:

The radical improvement of the Tennessee River, so as to make navigation continuous throughout its entire length for boats of moderate draft, is by no means an impossibility. The bed and banks are of such a character as to make any improvements practically permanent, with the exception of the removal from time to time of drift or snags that may be brought down by annual floods.

Report for 1893: Captain Biddle, engineer in charge, repeats statements made by former engineers to the effect that "the radical improvement of this river, so as to make navigation continuous throughout the entire year and for its entire length for boats of moderate draft, is by no means an impossibility."

Lieut. Col. H. M. Robert (afterwards Chief of Engineers) states:

All the Tennessee's tributaries flow over rocky beds. Their banks are protected by timber growth and there is no cutting or washing away. Altogether, the bed of the entire river is exceptionally permanent and all improvements are of lasting value.

Report for 1895: Captain Bingham, engineer in charge, states:

Below Riverton there is water enough at nearly all stages for Mississippi and Ohio river steamboats.

As one of the largest of the 53 or more tributaries of the Mississippi River, the Tennessee has always held an important place in the projects for the improvement of the navigable waterways of the country. The Muscle Shoals Canal having been opened to navigation, Tennessee River is now navigable from its source to its mouth, a distance of 653 miles, during several months of the year, and as work is continued upon certain other less formidable obstructions the season of navigation will be correspondingly lengthened.

The radical improvement of this river so as to make navigation continuous

throughout its entire length for boats of moderate draft is by no means an impossibility.

Now that the great obstruction of the Muscle Shoals has been overcome by the completed canal, and Colbert Shoals is in process of being done away with in the same manner, it is the more annoying to the now really brightening prospects for river navigation to have to contend with the smaller obstructions which exist in a number of places along the river. These obstructions are very short in length, but no whit less obstructive, and at times more destructive than the longer ones.

The improvements already attempted at many of these places have proved abortive, because the localities have been worked on independently. In so far as work has been confined to removal of bowlders and snags, it has been successful; but excavation, resulting in change of the conditions of flow, is very dangerous to attempt in river improvement unless long reaches above and below have been mapped, profiled, measured for discharge, and thoroughly studied beforehand. Without such preliminary study hoped-for improvement from excavation is more apt than not to result in developing obstructions at places which were navigable before.

Excepting for a sufficiency of discharge measurements, the necessary map and profile were made for the river above Chattanooga in 1891. For the river below Chattanooga many detached surveys exist, which are now being patched together. A continuous map and profile, with discharge measurements taken at different stages of water, is sadly needed for the entire river below Chattanooga. A comprehensive and logical plan for the complete improvement of the river will only then be possible.

Report for 1896: Captain Kingman, engineer in charge, states:

The radical improvement of this river so as to make navigation continuous throughout its entire length for boats of moderate draft is by no means an impossibility.

As one of the largest of the 53 or more tributaries of the Mississippi River, the Tennessee has always held an important place in the projects for the improvement of the navigable waterways of the country. The Muscle Shoals Canal having been opened to navigation, Tennessee River is now navigable from its source to its mouth, a distance of 653 miles, during several months of the year, and as work is continued upon certain other less formidable obstructions the season of navigation will be correspondingly lengthened. The radical improvement of this river so as to make navigation continuous throughout its entire length for boats of moderate draft is by no means an impossibility.

Now that the great obstruction of the Muscle Shoals has been overcome by the completed canal and Colbert Shoals is in process of being done away with in the same manner, it is more annoying to the now really brightening prospects for river navigation to have to contend with the small obstructions which exist in a number of places along the river, but no less obstructive than the longer ones.

Report for 1897: The Chief of Engineers, Gen. John M. Wilson, says:

The improvements which have already been made on this river are sufficient to demonstrate that the main trunk of the river can be made navigable throughout the year and that the useful season of navigation can be greatly lengthened on all of the tributaries.

The whole system, on account of the hard bottoms and stable banks, and from the fact that they are never obstructed by ice, is exceptionally susceptible to improvement.

In spite of many obstructions which still exist and the dangers and difficulties of navigation, the total value of freight carried on the river below Chattanooga in 1896 was nearly \$18,000,000, which is over four times the total amount spent on the improvement of the river in seventy years. However, 90 per cent of this commerce is on the river below Colbert Shoals, although the valley of this part of the river is not more productive than that above.

Major Kingman, engineer in charge, repeats assertions of General Wilson above quoted and states further:

The radical improvement of this river, so as to make continuous navigation over its entire length for boats of moderate draft, is by no means impossible.

Now that Muscle Shoals Canal is completed and Colbert Shoals is to be done away with, it is more annoying to the now really brightening prospects for river navigation to have to contend with the smaller obstructions existing in a number of places. These obstructions are very short in length, but no less obstructive than the longer ones.

The bed and banks of the river are of such a character as to make any improvements practically permanent. Such work as wing dams and retaining walls has been remarkably permanent, very little that has ever been built having ever been destroyed.

In the section of the river between Chattanooga and Riverton, the mountain section, is the worst obstruction. After the river passes the mountains it is generally wide and shallow with a gentle flow. Obstructions are broad, flat bars, sometimes of solid rocks, but oftener of hardpan, in which bowlders are embedded; at other places rock reefs.

Below Riverton the river affords the best navigation; it is below the largest tributary, carries the most water, width is not excessive, slope is uniform. For several months in the year the largest Mississippi and Ohio River boats can navigate it. During low water only light-draft boats can navigate; yet no great obstacles exist. Less attention has been paid to this portion of the river than the value and importance of its commerce requires, for three-fifths of all the business of the river and tributaries is done on this section. The majority of the obstructions are easy to remove.

Report for 1899: General Wilson repeats his statements in report of 1897 of what can be done with this river, character of its banks, consequent permanence of improvements, lack of ice, and states:

Notwithstanding the many obstructions which still exist, and the dangers and difficulties of navigation, commerce has increased, cost of transportation has been reduced. As less than \$7,000 was available at the beginning of the year, it was not possible to do much more than to take care of the plant.

Major Kingman says:

Work done has given an improved channel above Chattanooga and rendered the general navigation of this portion of the river safer and easier, and has permitted a reduction in freight rates; the work has been remarkably permanent.

Relative to the cost of operating and caring for Muscle Shoals Canal, he states:

It is worthy of note that said cost for the past year, exposed as the canal is to so many causes of deterioration and injury, has been a little less than 2 per cent of its original cost. This will compare very favorably with the cost of maintaining and operating any of the great works on land or water in the country.

Report for 1900: General Wilson, Chief of Engineers, repeats his statements about the practicability of improvements, character of banks and bottoms, and freedom from ice. Major Kingman states:

Since Muscle Shoals Canal has been opened Tennessee River contains no insurmountable obstacles from its source to its mouth, a distance of 652 miles, and it may be navigated over its entire length several months in the year. As the minor obstructions are removed the season of navigation will be lengthened; it is entirely practicable to so improve this river as to make navigation continuous throughout the year over its entire length for boats of size sufficient for the needs of commerce. Owing to its hard bottoms, stable banks, ample discharge, the river is particularly favorable for improvement, and as it never freezes, it escapes one of the principal obstructions to navigation found upon most fresh-water rivers. Work done has made navigation easier and safer, and has permitted a reduction in freight rates, and has been remarkably permanent. Very little that has ever been done has been destroyed.

Report for 1902: Gen. G. L. Gillespie, Chief of Engineers, says:

There were not sufficient funds on hand at the beginning of the fiscal year to do any work.

Major Knight, officer in charge, states:

Extensive mineral resources exist in the counties adjacent to the upper third of the river, but most of these are not directly on the river banks. With the exception of Sheffield and Florence, Ala., all centers of industry on the river are situated above the Muscle Shoals Canal. Through traffic by boats of deep draft is out of the question. Considering the dimensions, including draft, of tows navigating the Ohio River, it is at once manifest that, even during high stages of Tennessee River, competition on the two rivers for the delivery of bulk freight at points below their junction is not practicable.

The situation below and above Riverton, Ala., is different. Below it the transportation needs of the farmer and lumberman are now readily met by boats running the entire year.

Above Riverton other interests rule—those of the manufacturer and the merchant. Of the two the manufacturer is the better favored by railroad facilities, for, as a rule, large concerns have side tracks by which material is delivered or removed direct without additional cost of transfer by team. Not so the merchant, and from him especially comes the demand that the river may be so improved as to regulate railroad charges.

Report for 1904: Captain Barden, engineer in charge, states:

Through traffic on this river the entire year can only be rendered possible by a system of locks and dams. * * *

The construction of the Colbert Shoals Canal, now in progress, will extend navigation for the entire year 10 miles above Riverton. There are three sections of the river where by reason of present local traffic it may be advisable to build locks and dams to form a part of a comprehensive system between Riverton and the headwaters. These three sections are: In the vicinity of Knoxville; for about 10 miles below the mouth of the Clinch River, and between Guntersville and Hobbs Island.

The following are commercial statistics, for the past ten years, of the main Tennessee River:

Year.	Tonnage.	Estimated value.
1895	1,343,572	\$22,583,963
1896	1,619,382	20,660,226
1897	893,020	13,344,430
1898	1,045,750	14,362,142
1899	965,199	14,550,377
1900	1,846,886	14,452,535
1901	1,061,889	13,511,703
1902	1,672,399	25,224,860
1903	1,686,877	20,644,428
1904	1,607,463	30,003,304

FRENCH BROAD.

The French Broad is a "very copious river" (see report Brigadier-General Humphreys, Chief of Engineers, Ex. Doc. No. 167, 43d Cong., 2d sess.), rising in the Blue Ridge Mountains and several of its spurs in North Carolina, flows 121 miles in Tennessee, generally in a western direction, and finally unites with the Holston 4½ miles above Knoxville, Tenn., to form the Tennessee River. The upper portion of the river lies upon the elevated plateau east of the Smoky Mountains. In breaking through these mountains, and for 45 miles, the river is not susceptible of improvement and is useless for navigation.

Below the mountains for some distance the slope is still excessive, and it is not until it unites with the Nolichucky River, its largest and most important tributary, near Leadvale, Cocke County, Tenn., 70 miles from its mouth, that it becomes useful for navigation and

susceptible of economical and advantageous development. From that point it becomes a broad and beautiful stream. For this reason the Government has settled upon the mouth of the Nolichucky River as the upper limit of the river which is worthy of improvement.

The river first received attention from the Government in 1830, when Col. S. H. Long was authorized to make an examination. About 1835 the State of Tennessee undertook the improvement of the French Broad. The work done on it consisted mainly of the removal of obstructions and the construction of riprap spur dams, designed to contract the channel and increase the depth of water on the shoals. The work thus done was of immense benefit to the commerce of the river and to the inhabitants of the valley; yet it was, on the whole, improperly done and of no lasting relief.

The amount appropriated up to June 30, 1905, is \$97,000; the amount expended up to the same date is \$94,866.67. The work, although it has accomplished a certain measure of improvement, has not been carried far enough to accomplish what was proposed. It has also suffered very seriously because of the lack of comprehensive survey and plan of improvement.

The portion of the river—a distance of 70 miles—before mentioned as susceptible of improvement and useful for navigation, varies in width from 300 to 1,200 feet, with an average of 600 feet. Its banks are generally low, composed of such material as is not subject to erosion; its bottom is generally of rock, with some coarse gravel and boulders on the shoals; wherever improvement is necessary, it is invariably composed of solid rock. The river is generally free from sand bars; the records show that only a small amount of detritus is transported by the water. The area drained by the river is about 5,600 square miles of fertile and productive territory, the basin being 100 miles long and 90 miles wide at its greatest width. There is no railroad in the lower part of the valley, and the river affords the only convenient means of transporting its productions to market.

The low-water discharge of the river is 2,500 cubic feet per second. The following table of commercial statistics shows that the commerce of the river is of very great importance and that the river is unquestionably worthy of improvement.

Year.	Ton- nage.	Estimated value.
1895	42,808	\$1,333,962
1896	249,204	1,469,833
1897	70,756	617,256
1898	124,060	928,362
1899	102,263	779,705
1900	160,827	1,255,678
1901	103,340	922,032
1902	157,819	1,810,772
1903	102,076	1,069,453
1904	258,847	2,129,246

In 1900, Maj. Dan C. Kingman made a survey and examination of the French Broad, and declares that "the river is worthy of improvement for the distance hereinbefore mentioned, and that a sufficient improvement to secure throughout the year a navigable channel 3 feet in depth may be had by proper regulating works at a cost of less than \$280,000."

Col. H. M. Robert, division engineer, in forwarding Major Kingman's report on April 4, 1900, states:

I concur with Major Kingman in the opinion that the French Broad is worthy of improvement from its mouth to the Nolichucky River, to the extent of obtaining a 3-foot navigation, and I think it can be done for something like \$280,000 if the funds are furnished rapidly enough to allow of the most economical methods of construction.

Following are extracts from various reports of Chief of Engineers concerning this river.

Report for 1885:

There being no funds, no work since January, 1883. The improvements already made are permanent and valuable.

Commerce consists mainly of grain and general merchandise. The permanent character of improvements already made gives general satisfaction. Owing to lack of funds, only one month's work was done this year.

Report for 1887:

For the sake of economy, the work on this river has been carried on in connection with the upper Tennessee and its tributaries. The commerce has largely increased since the work was begun in 1880. Marble is fast becoming a large factor.

Report for 1888:

Commerce of the French Broad is considerable and rapidly increasing, and consists of logs, lumber, grain, shingles, marble, sand, and general merchandise. The prospective advantages to navigation, as well as present benefits to the community, by completion of the contemplated improvements, are the increase of transportation facilities for the products of a rich agricultural and mining region of the upper waters, by means of a safe navigable channel. Improvements made, although limited and incomplete, appear to give satisfaction to boatmen.

The mineral wealth of the territory drained by this river and its tributaries awaits the completion of a safe and economic highway from mine to market to aid in its development.

Report for 1889:

The commerce of this river is rapidly increasing, and the extending of the facilities offered by this improvement will materially aid in the development of the mineral wealth and the rich agricultural lands drained by this river and its tributaries.

Report for 1890:

The improvement of this river is of vital interest to the many interests of the inhabitants along its banks. Commerce has already reached considerable proportions.

Report for 1891:

The improvement of this river is of vital importance to the many interests of the inhabitants. Commerce of the stream has already reached considerable proportions.

Captain Newman, of steamboat line, writes as follows:

Before there was any work on this river by the Government we could not run over six months in the year, but, with anything like ordinary water, we can now run all the time. But much remains yet to be done. As it is, only small steamers can ply on the river at all, while with some more work we could ply with much larger steamers. Before any work was done by the Government it usually took a boat from one-half to one and one-half days to go through. Now we can go through in forty-five minutes.

Report for 1893: Colonel Robert repeats statements of former engineers as to importance of improving this river; that it is con-

stantly being used by the people; that the mineral and agricultural wealth of the region drained is very great.

Report for 1894: Captain Biddle repeats statements made by his predecessors about importance of commerce of the river and necessity of improving same.

Reports for 1895 and 1896:

The improvement of French Broad River, Tennessee, is of importance to the inhabitants along its banks not only by reason of its increasing commerce, but because of its being constantly used as a highway for travel by the people themselves, a large number of passengers being carried by the small steamers that ply upon this stream. The commerce consists principally of marble, sand, logs, lumber, forage, grain, live stock, wood, and general merchandise. The completion of the existing project of improvement will materially aid in the development of the mines and will open a river highway for the transportation of the mineral wealth of the mountains and the products of the rich agricultural lands of the region drained by the river and its tributaries.

Report for 1897:

From Knoxville to Leadvale, 90 miles, this river is exceptionally beautiful and broad and adapted to navigation. Has obstructions usual to a mountain stream. * * * [Repeats what has formerly been stated.]

Report for 1900:

Under the present plan, operations have been carried on at the most serious obstructions, but as a rule they have not been carried far enough to fully accomplish what was proposed. The work has suffered seriously from a lack of an adequate survey and a comprehensive plan of improvement. Appropriations heretofore made have been too small.

No work was done on this river during the past year. The funds available were not sufficient to make it economical and advantageous to do so.

Report for 1900 and 1901: Gen. A. Mackenzie, Acting Chief, states, on page 3019:

The river is stated to be worthy of improvement, and the division engineer, Col. H. M. Robert, Corps of Engineers, who concurs in this opinion, states that a 3-foot navigation can be obtained for something like \$280,000 if the funds are furnished rapidly enough to allow of the most economical methods of construction.

The banks are generally composed of a stiff, resisting clay, and as a rule do not appear to be subject to erosion. The bottom of the river is of sand, gravel, and rock in the deeper portions, and generally of solid rock or coarse gravel and boulders on the shoals. The valley of the river is broad and fertile, and is quite generally cleared and under cultivation. There is no railroad in the valley, and the river affords the only convenient means of transporting its productions to market. The area drained by the river is about 5,600 square miles. The length of this basin is about 100 miles, and its greatest breadth about 90 miles. This river already has a very considerable commerce. In the year 1898 about 125,000 tons of freight was moved upon it, and the aggregate value of the commodities so transported was nearly \$1,000,000. This would indicate that the river was worthy of improvement provided a reasonably permanent and satisfactory improvement could be attained at a moderate cost. In the case of the French Broad the banks are stable and the bottom, wherever improvement is necessary, is almost invariably composed of solid rock.

Report for 1902:

No work done this year, as there were no funds.

CLINCH.

Clinch River rises in the Cumberland Mountains, in the southwestern part of Virginia. It runs southwesterly 165 miles in Virginia and 230 miles in Tennessee, emptying into Tennessee River at Kings-

ton, Tenn., 105 miles above Chattanooga. It has two principal tributaries, the Powell and the Emory.

Clinch River was slightly and temporarily improved by work done by the State of Tennessee in 1830 and 1842. The General Government first recognized the river by an examination made in 1875. First appropriation for work on the river was made in 1880.

The area drained by the Clinch is about 5,000 square miles, the basin being 250 miles in length and of an average width of 20 miles. The total length of the Clinch is about 250 miles, and is navigable by steamboats part of the year from its mouth to Coal Creek, Tenn., a distance of 75 miles. Within this distance the river is susceptible of low-water improvement.

The low-water discharge of the Clinch is 1,300 cubic feet per second. The average fall is about 1 foot to the mile. On page 2549 of the Annual Report Chief of Engineers, 1901, Maj. Dan C. Kingman states:

It is a very pertinent question as to whether the time for improving this river has arrived. There are so many improvements to be made in the internal waterways of the country that it is but reasonable and proper that the more important ones should receive the earliest attention. I believe, however, that the time has come for the improvement of the Clinch. If the mineral resources are as great and valuable as there is every reason to believe them to be, the improvement of the navigation of this river, together with that of the Tennessee, is a work of truly national importance.

It may be interesting to institute a slight comparison between this river and the Ohio. The demand for coal along the valley of the lower Mississippi River is now great and will surely increase, and no doubt there will be a large demand in the immediate future for export coal at New Orleans. The distance from Cincinnati to New Orleans is about the same as that from Chattanooga. The distance from the Coal Creek coal fields to New Orleans is nearly 400 miles less than from Morgantown, on the Monongahela, and the altitude above sea level is about the same.

The low-water discharge of the Ohio River at Pittsburg is about one-half that of the Tennessee at Knoxville, and the low-water discharge of the Ohio at Paducah is the same as that of the Tennessee at the same point. The total amount expended already for the improvement of the Ohio River and its tributaries far exceeds that expended on Tennessee River, and the amount estimated as necessary for the completion of the proposed works is also very much greater. I believe that the Tennessee is susceptible of as high a degree of improvement as the Ohio, and that it, with its tributaries, can be developed into an exceedingly valuable system of waterways.

Clinch River can be improved as far as Coal Creek by locks and dams (fixed or movable) for \$1,460,000, and this will, at the same time, secure the improvement of Emory River to Harriman, Tenn. This is the best, the most certain and satisfactory form of improvement that can be devised for this river, and permits the fullest development of commerce, and, in my opinion, it should be adopted whenever the improvement of the river is undertaken.

The banks of this river are of such materials, and are so protected, that erosion is unknown. The bed of the river is composed of rocks, with occasional gravel on the bottoms of pools.

The valley drained by the Clinch is extremely fertile and rich in resources. Zinc and lead are being mined in large quantities, also copper and iron.

Lumbering has long been one of the chief industries, and the millions invested in the manufacturing of lumber in the cities on Tennessee River owe their existence to the unexcelled supply of timber on the Clinch and other tributaries.

The total amount appropriated by Congress for the Clinch River up to June 30, 1905, is \$54,500, and the total amount expended up to

June 30, 1905, is \$52,472.49. The project upon which these expenditures have been made was to secure better high-water navigation; 2 feet in the channel up to Clinton—60 miles—and $1\frac{1}{2}$ feet thence up, 66 miles; for the remaining 67 miles, removal of temporary channel obstructions.

Commercial statistics for the past ten years show the success of what has been attempted by way of improving this river.

Year.	Tonnage.	Value.
1885	68,900	\$439,409
1886	89,456	357,788
1887	102,629	906,238
1888	160,345	866,759
1889	185,691	2,391,625
1890	182,511	1,462,235
1901	164,586	1,633,104
1902	129,925	2,272,348
1903	161,716	2,847,372
1904	100,701	1,990,696

The following extracts, relative to the Clinch, from reports of Chief of Engineers, in addition to that of Major Kingman in 1901, above quoted:

Report for 1883:

From 1830 to 1845 the State of Tennessee spent considerable money to improve this stream, under very poor methods. However, the commerce of the river increased so as to outgrow those primitive improvements. With the progress of later improvements the commerce of the river has increased so rapidly that it has become necessary to increase width of channel to nearly double the width originally considered necessary. Merchants, manufacturers, river men, farmers, all have promptly utilized the river as fast as the improvements have become available, and have tried to bring down their boats when the river was less than 6 inches above extreme low water. They could pass safely over the improved portions, but were stopped at shoals that had not been improved for want of funds available.

Report for 1884:

The valley of the Clinch is so isolated from the rest of the world as to make the river the main highway by which the products of this valley find their way to market. But one railroad is accessible. These facts explain why the improvements already made are so promptly utilized—the rapid increase of commerce and the anxiety of the people for the early completion of the projected improvements.

Report for 1885:

There being no funds, no work since July, 1883.

Report for 1886:

The first appropriation was made in 1880, and its expenditure was limited to the waters in Tennessee; this limitation has been continued in all subsequent appropriations.

The results of work done in previous years show that from 2 to 3 feet lower water will still allow boats to pass; work has given general satisfaction to river men.

Report for 1887:

This year's appropriation became available so late that no work was done.

Commerce on the river has increased rapidly since work was begun, this river forming the most available highway for reaching a market, there being no railroad accessible to the farming and lumber interests of its upper waters. The commerce of that section of Tennessee River called "above Chattanooga" is

largely made up of the aggregated shipments from its upper tributaries. Large quantities of grain, lumber, and stock are brought down these streams on the "rain tides" in flatboats, the owners of which dispose of their shipments to the best advantage along the route and return to the upper waters, leaving no record available that can be compiled in commercial statistics. It is this tributary commerce along these minor waterways that increases the decidedly heavy commerce of the main stream.

The work done is permanent, and the results of the work are very satisfactory to those interested. It has given added safety to commerce, an increase in business to merchants, and a decrease in cost of transportation.

Reports for 1888 and 1889:

Clinch River is the great outlet and highway for timber, zinc ore, and products of the rich agricultural and mining sections drained by this stream and its affluents, exceeding an area of 4,500 square miles, and there are no railroads readily accessible to the varied interests of the upper waters. The people of the valley have promptly used the river with already made improvements, and the commerce of the river is rapidly developing.

Report for 1891:

The principal commerce is logs and zinc ore; immense tracts of uncut timber still remain adjacent to the river, and will for a long time to come require its channel as a means of transportation. The zinc is still brought down in flatboats to the works at Clinton. The ore deposits are very extensive and depend on this river.

Reports for 1892 and 1893: Colonel Barlow repeats statements made by former engineers as to importance of this work.

Report for 1893: Engineer repeats statements of former engineers of importance to complete work and of the commerce.

Report for 1896:

No work this year on account of lack of funds.

Report for 1899:

There still exists a very large area of fine timber within reach of the headwaters of the Clinch, and which can be taken to market on this river. Any work done that will facilitate rafting on the upper river, or that will lengthen the season of navigation for same, will be of immediate value to commerce, and the greatest value which can be secured at moderate expense.

Report for 1902:

Only expenditures were for care of property.

HIWASSEE.

The headwaters of the Hiwassee lie in the mountains of northern Georgia and western North Carolina, flow northward into and through western North Carolina, thence through the counties of Polk, Bradley, McMinn, and Meigs, in the State of Tennessee, flowing into Tennessee River about 40 miles above Chattanooga.

Its length is about 85 miles. It drains an area of 3,425 square miles in extent. It has a number of affluents, its largest being the Ocoee, which enters it 35 miles from the mouth from the south. The upper portion is not susceptible or worthy of improvement. After receiving the waters of the Ocoee River—402 cubic feet discharge—its character changes, slope becomes gentle, and the volume of its low-water discharge is plenty large to permit of improvement by regulation. Hence Savannah, 42 miles from its mouth, is taken as the head of navigation. From this point downward the width averages 350

feet. The banks are composed of rock or hard resisting clay, with average bank height of 15 feet, and show a very stable character. The bed of the river is composed of rock, with a few islands and no shifting sand bars.

There never have been any signs of erosion of any consequence on this river. The average fall of the river is less than 1 foot per mile, the rainfall of the basin of the river and its tributaries is ample, and the channel, bed, and banks are of such character that it is eminently practicable to obtain and maintain a boat channel of sufficient width and of a depth of $2\frac{1}{2}$ feet in ordinary low water and a maximum depth of 3 feet at a cost of about \$71,000. As stated by Maj. Dan C. Kingman, who made the survey and report in September, 1900:

This is a very moderate sum for a river of this size, and its smallness is an indication of the naturally favorable conditions of the river. The amount of water carried by the river is sufficient to afford satisfactory navigation in a river with so moderate a slope.

The Hiwassee even in its natural condition was capable of being navigated under favorable circumstances, and it has been made use of since the earliest settlement of the country. In 1830 and 1842 the State of Tennessee appropriated money for its improvement. The early works done with these appropriations, although inadequate to perform the work desired, added greatly to the safety and convenience of navigation, and favored largely the development of the country tributary to the river.

The Government made its first appropriation for work on this river in 1876; subsequent Congresses appropriated small sums until 1890, when they were discontinued until 1902, when a small allotment was made. In 1905 another allotment of \$4,500 was made. In 1896, there having been no appropriations, the Chief of Engineers dropped the river for several years from the list of rivers to be improved. The total amount appropriated for this river is \$51,000. The total amount expended up to June 30, 1905, is \$36,522. This amount has been expended under two projects, the first of which was adopted in 1874, for a channel of 40 feet wide with a 2-foot depth at ordinary low water. The present project, adopted in 1902, is for a channel 116 feet wide and not less than $2\frac{1}{2}$ feet between the mouth of the river and the mouth of the Ocoee River, near Savannah, by the ordinary methods of regulation works, at a cost of about \$71,000.

It is evident from the official reports that these amounts appropriated have not been sufficient to secure the proper improvement of the river. The work done has only secured a partial improvement of same, in removing obstructions and lowering the depth of the channel to some extent. That future commerce will rapidly increase is evidenced from the reports, and from the fact that the mountains are filled with the best and finest of marbles, iron ores, clays, and many other minerals, building stone, and some of the finest timber remaining in our American forests. As one of the most important tributaries of Tennessee River, the Hiwassee is worthy of more extended improvement.

General Wilson, Chief of Engineers, concurs with Major Kingman, officer in charge, and Colonel Robert, division engineer, in the opinion that the Hiwassee is worthy of such improvement. (Report Chief of Engineers, 1900.)

G. T. Nelles, assistant engineer, who made the survey, states:

All persons familiar with the past and present conditions of the river testify that the works executed have increased the efficiency of the stream and greatly benefited the country tributary.

The country drained by the Hiwassee is mountainous, but contains much very rich farming land, large tracts of splendid timber, and valuable and extensive deposits of iron, slate, zinc, gold, marble, limestone, and copper, the latter being very extensively worked at Ducktown, Tenn., where over 1,500,000 pounds of copper are produced annually. The farm lands are much superior to the average East Tennessee farm lands, although the want of capital for years has hindered the proper development of same.

The following table of commercial statistics shows that the commerce of the river is extensive, and demonstrates that the improvement of the river is demanded:

Year.	Tonnage.	Estimated value.
1896	8,876	\$145,431
1902	16,041	340,207
1903	13,852	412,412
1904	8,003	77,580

Statistics not obtainable for the years 1896 to 1901, inclusive.

Following are statements from reports of Chief of Engineers in reference to the Hiwassee:

Report for 1883:

The appropriations for this river have been so small that a considerable portion of them has necessarily been expended in taking care of the plant and other constant expenses. This has made the work actually done cost excessively, and it can not be otherwise with such small appropriations.

Reports for 1884 to 1886:

There being no funds available and no appropriation, work has been suspended since November, 1882. Improvements already made are valuable and permanent.

Reports for 1887 and 1888:

The prospective advantages to navigation as well as benefits to the community by continuing the improvement to completion are the maintenance of a clear navigable channel at ordinary stages of water for steamboats of light draft to Charleston, and for flatboats as far as Columbus, Tenn. The character of the stream is such that a small annual outlay will be necessary to preserve and maintain the improved channel by removal of snags, etc., that come down during flood seasons.

Report for 1889:

The commerce of this river is rapidly increasing.

Reports for 1890 and 1891:

No work done this year on account of lack of funds. The funds heretofore appropriated have not been sufficient to secure radical improvement of this river.

Report for 1892:

The completion of the improvement contemplated will open a river highway for the transportation of the great mineral wealth of the mountains, and will materially aid in the development of the mines in its locality. Marble, sand, logs, lumber, forage, grain, live stock, wood, and general merchandise make up the commerce of this river.

Report for 1896:

No work since 1892, there having been no appropriation.

Reports for 1895 and 1896:

No appropriations since 1890. No work since September, 1892.

Report for 1900: General Wilson, in a letter to Secretary of War Root, states:

Major Kingman is of the opinion that Hiwassee River is worthy of improvement. In transmitting to this office the preliminary report upon the survey of this river, Colonel Robert, division engineer, states that this preliminary report indicates the Hiwassee to be worthy of improvement. The views of Colonel Robert are concurred in by me.

Savannah Ford, 33 miles from the mouth, is the head of navigation, and steamers have occasionally reached that point. River runs through a series of ridges over 100 feet in height. Between the ridges are valleys, forming a large and rich district tributary to the river, as it is easier to haul down the valleys to the rivers than across the ridges to the railroad stations. The people are principally farmers. Farm lands are as a rule superior to the average East Tennessee lands. Because of the difficulty of river navigation much produce is hauled the greater distance to the railroad stations.

The mineral resources of the mountain regions of Hiwassee River valley are quite extensive. The product of the Ducktown copper mines, 25 miles above the mouth of the Ocoee, was formerly shipped on the Hiwassee, after hauling a long distance to the head of navigation. Winter is the freighting season, and flatboats and steamboats drawing from 18 inches to 3 feet carry commerce during winter tides, which are said to average a little less than 2 feet above low-water mark. I think the Hiwassee is undoubtedly worthy of improvement. Total amount appropriated has been expended and no work since 1892.

HOLSTON.

Holston River is formed by the confluence of its North Fork and South Fork at Kingsport, Tenn., below which point it has no large tributaries. Four and one-half miles above Knoxville, Tenn., and 141½ miles below the junction of "The Forks," it unites with French Broad to form Tennessee River. Its headwaters rise in the Blue Ridge and the spurs thereof in southwestern Virginia. Its general course is southwest and parallel to the Norfolk and Western Railroad. It is also parallel to Clinch River.

Its total length from "The Forks" to the mouth is 141½ miles, and the average fall per mile is about 2½ feet, which is quite evenly distributed, but largely concentrated at about 100 places where low-water depth is less than 2 feet. About 25 per cent of the total length is thus obstructed, so as to seriously interfere with if not altogether stop low-water navigation. Steamboats now navigate the river for about 50 miles. The low-water discharge is about 1,000 cubic feet per second.

The Holston first received the attention of the General Government in 1830, when Col. S. H. Long made an examination. The State of Tennessee, about 1830, did some work on the river intended simply to remove snags and bowlders and to confine the flow of the water.

A partial examination was made in 1881 by the Government and in subsequent years, and final report thereon submitted in 1887. In 1899 a survey was made by Major Kingman below "The Forks." No appropriation was ever made until 1902, when \$5,000 was allotted to work on this river, which has been partially used to remove snags and bowlders.

The average rainfall of the valley of Holston River is 45 inches per annum, very well distributed.

The early plans proposed contemplated a low-water channel from near "The Forks" to near Knoxville by regulation works and removal of temporary obstructions. Later surveys show this impracticable, and slack-water improvement is now deemed by engineers to be the best plan to be adopted.

The banks of this river are composed of stiff clay and rock; are generally steep and 10 to 15 feet high, covered with heavy timber and undergrowth. The bed of the river throughout its entire length is composed of rock at times covered with fine gravel. Sand bars are very rare, the shoal places being composed of rock. Little or no detritus is carried by the water.

The area drained by the Holston is about 4,000 square miles of very rich and productive country. This area averages about 15 miles in width. At the junction of North Fork and South Fork the valley is 50 miles in width, with a total length of about 175 miles. The bottoms along the river are generally flat and fertile. The high land is covered with magnificent timber in great abundance, this territory being part of the only remaining dependable hard-wood timber belt of the United States.

Lumbering and rafting are carried on extensively. Agriculture and cattle raising are the chief industries. Magnificent marble is being quarried in several places.

Extracts from the Reports of Chief of Engineers concerning this river are as follows:

Report for 1885:

Examinations made in 1830 by Colonel Long, also in 1881 by Sanborn. These reports were laid before Congress, yet nothing has been done to appropriate money for improvement. The interests of commerce justify its improvement now, as they did when said reports were made.

Report for 1887:

This river drains an area of about 3,680 square miles and is one of the four copious tributaries that pour their waters in a combined discharge, within a short distance, into Tennessee River. Low-water discharge of Tennessee River is 1,400 cubic feet per second above mouth of the French Broad, but after receiving the waters of the French Broad the volume is so increased as to secure from 3 to 5 inches greater depth in the natural low-water channel in the remaining 4½ miles of its subsequent course to the Tennessee.

All obstructions can be easily removed. The improvement will be practically permanent and the season of navigation be lengthened by securing an open, navigable channel of an average width of 100 feet and 20 inches in depth at natural low water from Knoxville to Noe Branch.

The commerce of the Holston consists largely of log rafts and flatboats loaded with grain, agricultural products, and timber. This river, like all others of like character, flows through a rich and fertile region, remote from transportation. It forms the main highway because it is very easy of access as a means of transit. A large amount of the commerce seeks a market at the business centers of the lower Tennessee, 350 miles from the Holston.

One appropriation of \$5,000 has been made for this river, of which \$3,523.90 has been expended up to June 30, 1905. To improve same, \$347,000 is estimated.

The banks of the river are fixed, being rock or rocky hills on one side and farm lands on the other. It traverses a most fertile region, well timbered and abounding in marbles deservedly noted for their variety, delicacy of coloring, and ease of working. During the past year about 300 boats came out of the Holston River to Knoxville.

Report for 1904:

In 1902 Congress made its first appropriation for this river—\$5,000.

LITTLE TENNESSEE.

Little Tennessee River rises in the Blue Ridge Mountains, near the boundary line between Georgia and North Carolina. Its total length is 134 miles, but the navigable portion, 40 miles, lies entirely in Tennessee. It flows in a northwesterly direction and into Tennessee River near Lenoir, Tenn., 137 miles above Chattanooga.

This river drains an area of about 2,600 square miles, rectangular in form, and 90 miles long by an average of 30 miles wide. The average rainfall is 52 inches. The low-water discharge is 1,355 cubic feet per second. The banks are such that no erosion or caving occurs at any stage of water. The bottom of the river is composed of rock and gravel, and the stability of the bed and banks is very marked.

The river was surveyed in 1874 and 1875. In 1881 and 1900 reexaminations were made. The estimate of the last survey is to obtain a low-water channel $2\frac{1}{2}$ feet deep and 100 feet wide, at a cost of \$209,000, extending the work over four seasons.

The Little Tennessee flows through a fertile and well-cultivated valley, in which there is no means of transportation except the river. It would be of great value to the agricultural interests of the valley to improve the river, but more particularly so to the great mineral and timber resources. Very valuable mines are directly tributary to the river, especially slate, which are the best and practically the only deposits in the South.

The hard-wood timber in the area drained by this river is perhaps the choicest of any in the Southeast. Splendid marble and iron ore await the development of this river for their being brought into the markets of the world.

In report of 1901 Major Kingman urges very strongly that the river be improved, which is concurred in by the division engineer. There has been appropriated and expended on this river \$5,000. In Report of Chief of Engineers, 1887, is the following statement:

There has been only one appropriation, and the money has all been expended. The results have been the safe passage of rafts and flatboats and light steamboats, lengthened season of navigation, diminished danger of "rain tides." As this river forms the principal highway for the products of the rich agricultural and mineral country through which it passes, these interests would be greatly developed and extended by the opening up of an improved channel for a safe and economical line of transit to the commercial centers of the lower Tennessee.

THE SIGNIFICANCE OF THESE FIVE GREAT REPOSITORIES OF WEALTH THAT AWAIT DEVELOPMENT THROUGH SCIENCE AND INDUSTRY ALONG THE COURSES AND WITHIN THE WATERSHEDS OF THE HIWASSEE, THE LITTLE TENNESSEE, THE FRENCH BROAD, THE HOLSTON, AND THE CLINCH RIVERS.

The overruling Providence that controls the destiny of the United States and of all nations and peoples seems to have held these great resources of civilization in reserve to supply the wants of other localities as they are disclosed by the rapid growth of the facilities of transportation that draw together the distant parts of the world into closer social, industrial, and commercial relations.

The rapid increase of transportation routes and facilities that are established, and the still greater development now in process of construction, have created new necessities for the vitalizing food and sustenance of commerce that now points the way to the southern reaches of the Blue Ridge and the Alleghenies and their valleys and rivers with the unerring hand of destiny.

These mountains and valleys and their water courses show a combination of the powers of nature in support of the highest civilization that is nowhere equaled in solid value and is not excelled in the variety of its resources.

In the brief notes above copied from the careful surveys made by our engineers, which are greatly amplified in their full reports, that are of the highest authority, we find vast areas of the most productive soils, yielding enormous crops of food, cereals, and textiles, fruits and grapes, and forests that are almost primeval and include all the varieties of trees that grow in the Temperate zones, and vast beds of coal and of iron, zinc, lead, and copper ores, and rich veins of gold, and great quarries of marble that excel those of Italy in texture and in the varieties of beautiful coloring, and all the slates and rocks that are useful and beautiful in architecture, and the hills crowned with the plumes of stately pine forests that never fade or fall, and the hills and valleys decorated with fields of cotton that, like bridal wreaths, welcome the coming of the snows and the hoar frosts of northern winters.

The beauty of this mountain region and its salubrious climate and springs of pure waters can not fail to attract the many millions of people who are searching the world over for pleasant homes.

In the industrial outlook there is a factor of supreme value which is above price. It is the water power that is afforded by the thousands of slight obstructions formed by ledges of rock that cross these streams and their affluents.

The aggregate of these water powers and the details as to their respective values will not be known for a great number of years, but the present value of those that are most conspicuous and inviting for the development of power for driving machinery is many times greater than the value of all the coal that underlies eastern Kentucky, eastern Tennessee, and western North Carolina for such uses.

This added capacity for generating power to drive local machinery sets free a vast amount of coal for export that would otherwise be consumed at or near the coal mines. This is an unfailing element of wealth that is nowhere found in such supply or so intimately associated with all the productive industries as it is within the watershed of Tennessee River and its affluents.

This great field for the production of power by the use of water or steam-generating fuel is also the native ground of splendid forests, fertile fields of agriculture, vast mineral deposits, and veins of ores. The material for manufactures and the power to convert them into articles of indispensable necessity and into the finest fabrics of handicraft are in the most intimate association within the watershed of Tennessee River, and they are all awaiting the helping hand of Congress to afford them a living chance in the competitive markets of the world.

VI.

NAVIGATION OF TENNESSEE RIVER.

The sources of the Tennessee and Ohio rivers are in the great Appalachian Range of mountains. They flow to the Mississippi through a region of uplands separated by low intervening elevations that scarcely demark their respective watersheds after they leave the mountain range. Their minerals are the same; their forests are practically the same; their fruits, grasses, and grains are the same; their textiles are the same, except as to the cotton growth, and they unite at Paducah, within 42 miles of the Mississippi River. Their identity, in a commercial sense and as to the character of the population that inhabits their watersheds, is complete throughout the great region that includes the Illinois, the Ohio, the Cumberland, and the Tennessee rivers. Whatever Congress does for the improvement of one of these rivers is for the benefit of all.

Taking the Ohio and Tennessee rivers as the leading channels of commerce in this great area, and considering the identity of the purposes they serve and of the benefits they confer, it is clearly just and right that the improvements to be made in their navigation should be regulated by a common standard, as far as practicable, and should be in accordance with one continuous system, to be established by Congress and steadfastly adhered to.

It is the absence of such systematic work and expenditures that has heretofore created jealousies between those especially interested in certain sections of the two great rivers.

A more unnecessary, unprofitable, or destructive rivalry and bickering could scarcely be found in any country. A proper system of improvements for both these great rivers, in which all are practically agreed, and is firmly established, is at the foundation of true, steadfast, speedy, and economical work in this great public duty.

These are twin rivers in all material respects and require systematic uniformity of treatment by Congress. Their respective affluents should be cared for as to the times and the amounts of appropriations and as to other regulations, in accordance with their contributions of commerce to the main channels and the necessities of the people who are to use them as the country is more fully developed.

MAXIMUM AND MINIMUM DEPTHS OF THE MAIN CHANNELS.

Pittsburg and Paducah for Ohio River and Knoxville and Paducah for the Tennessee are the established points between which Congress should now prescribe the laws to regulate their future navigation on a common basis, as to the maximum and minimum depths of their channels at all places where their present depth does not exceed the maximum so established.

The maximum depth of channel at such places should be fixed as a permanent basis, or foundation plan, that will stand as a basis for present legislation and future operations, so far as can now be determined, and is therefore the major proposition in the great problem to be solved.

CONGRESS HAS ESTABLISHED A MAXIMUM DEPTH.

Congress, for reasons that probably have reference to the necessities of a particular section or the advantage of manufacturers and shippers at Pittsburg, has established a 9-foot channel as the depth of the main affluent of Ohio River, and has appropriated the money to provide such a depth of channel by means of locks and dams.

It can not be imputed to Congress that it found special reasons for establishing this depth of channel above Pittsburg, and that the entire length of Ohio River below Pittsburg should be excluded from such advantages, either by reason of natural obstructions in that river or for economic reasons.

It must be assumed, the contrary not appearing, that Congress thus established a 9-foot channel as the proper basis of improvement of the navigation for Ohio River in its entire extent, to be provided in accordance with a wise and just financial economy, from time to time, as the improvements progress.

The present low-water depth on the obstructions of Mississippi River indicate that vessels of even 13 feet draft coming out of Ohio River can pass to New Orleans at all seasons without obstruction or that such a depth of channel can be easily provided.

This fact establishes the proposition that Congress has acted wisely in providing a 9-foot channel as the present minimum depth of Ohio River, to be worked out in future to a depth of, say, 12 feet. The wisdom of this action of Congress is supported by every fact that relates to the local and national value of this great water course for commercial purposes, and is sustained by the right of the people to have their navigable water courses improved for their common benefit, so that boats which can navigate the shallowest parts of the Mississippi as far north as Cairo shall be able to navigate the Ohio to Pittsburg and the Tennessee to Knoxville.

It is unnecessary to attempt to state all the facts that sustain this action of Congress, nor is it possible at this time, for they will multiply and increase in number and importance as time advances.

This decree of Congress, that Ohio River is to have a 9-foot channel at all places of obstruction, will never be reversed.

MAXIMUM DEPTH IS THE BASIS OF ALL IMPROVEMENTS.

The most important inquiry with which this committee is charged is to ascertain whether a 12-foot channel between Knoxville and Paducah is practicable, at a reasonable cost.

We have already stated some of the broad foundations of justice and of public necessity and economy on which the claim for a 9-foot channel in favor of Tennessee River is based, and will proceed to further establish it and to show that a 12-foot channel is practicable. In doing so the committee will make some comparisons of actual conditions as to the two rivers, with no intention to make them invidious.

We believe that a 12-foot channel is practicable for both rivers and that a wise economy in their improvement will keep this ultimate result constantly in view, especially in making contracts with private persons and corporations for building locks and dams in consideration of the grant of the use of water power.

LEADING AND CONTROLLING CONDITIONS AS TO THE SUCCESSFUL NAVIGATION OF THE TWO RIVERS WITH A CHANNEL OF 6 FEET, 9 FEET, OR OF 12 FEET.

First, as to the water supply to give and maintain a 12-foot depth of channel at all seasons of the year:

The altitude of Tennessee River at Knoxville above sea level is 792 feet.

The length of the river to Paducah is 652 miles.

The average fall per mile is 0.79 foot.

The velocity at the lowest stage of water at Knoxville is 1.75 feet per second, and the volume is 3,000 cubic feet per second.

At Paducah the velocity of the Tennessee River is 1 foot per second and the volume is 10,000 cubic feet per second.

Ohio River at Pittsburg is 699 feet above sea level.

The length of the river to Paducah is 917 miles.

The average fall per mile is not given in any official report.

The velocity at the lowest stage of water at Pittsburg is not given in any official report.

At Paducah the velocity of Tennessee River is 1 foot per second and the discharge is 10,000 cubic feet per second. Major Kingman states in his report that the volume of water of Ohio River at Pittsburg is about half as great at the same stage of water as that of the Tennessee at Knoxville, while the two rivers are equal in the volume of water at their junction at Paducah.

The two rivers being identical in volume at Paducah, and a 9-foot channel for the Ohio being a proper depth of navigation to Pittsburg, as fixed by acts of Congress, there can be no reason why that depth of channel is not practicable to Knoxville, where the volume of water is twice as great as it is at Pittsburg. The rivers that empty into the Ohio below Pittsburg are larger and longer than those that flow into the Tennessee below Knoxville, which accounts for gain in the volume of water of the Ohio at Paducah, where it equals that of the Tennessee.

Tennessee River has ample water to supply a channel as deep as 12 feet between Knoxville and Paducah, if such a channel is ever needed; but that depth of channel being available in both the great rivers equalizes their claims for improvement upon the common level of a 12-foot channel and, for the present, this draft of vessels is as deep as the Mississippi River can float across its obstructions at its lowest stage of water.

These facts settle the great primary question that the maximum depth of the Ohio and Tennessee rivers, to be established as the basis of future improvements, should be 12 feet, and at present it should be 9 feet. And, this point being settled, the approximation to either depth in each river in their further improvement is a question of public convenience.

While rivalry and competition between these great water courses is for the public good, and is commendable, an improvident or unjust discrimination against either of them is a wrong to the entire country, and is a positive disadvantage to the commerce of both rivers and to the people who reside upon or near to each of them.

A boat loaded with commerce at Pittsburg and destined to Knoxville has as much right to the convenient navigation of Tennessee

River as it would have on Mississippi River if it was destined to New Orleans.

OBSTRUCTIONS.

On the Ohio and Tennessee rivers it has been found necessary to abandon the natural channel at some of the obstructions in order to connect the navigable waters of each, which extend, in full volume, for hundreds of miles above and below such natural obstructions that can only be surmounted by canalization along their banks.

In this respect the expenditures for constructing such canals has been and will be much the same on both rivers if they are controlled by a regard to economy.

But whatever such expenditures may be, to the extent that they are necessary, they are indispensable as a duty resting upon the Government.

The canal at Louisville, on Ohio River, is likely to require larger expenditures, in the long run, than Colbert Shoals and Muscle Shoals canals, both for construction and maintenance, because of the permanent character of the land through which the Tennessee River canals are constructed, and because Ohio River and its tributaries are, largely, silt-bearing and ice-obstructed streams, while the reverse is true of Tennessee River and its tributaries.

These are material and very important advantages in favor of Tennessee River in respect of the sums of money that will be necessary to give it a 12-foot channel, or any lesser depth, between Knoxville and Paducah, and the still more important matter of the maintenance of its navigation through all coming time.

Ohio River has a natural obstruction for about three months in each year, in the freezing of its waters, as far to the south as Louisville, and in the ice flow along its channel in the spring season, which is perilous to shipping. No such obstructions exist in Tennessee River.

EFFECT ON FOREIGN COMMERCE.

Times will occur, when the isthmian canal has become the great highway for the steamers that bear the commerce of the great oceans on the shortest direct lines of navigation between the coasts of all maritime countries, that a constant and full supply of steaming coals to supply these fleets will be of importance to the whole world.

Then, access by interior waters to the coal fields of the Appalachian Mountains throughout the year will be an affair of great national necessity as well as of commercial importance.

Mississippi River up to Cairo, the Tennessee and Ohio rivers up to Paducah, and Tennessee River up to its head of navigation are the only water courses, except the Cumberland and the Alabama, that can open the way to the coals of the Appalachian Mountains throughout the year, and their importance is accordingly magnified. On this water route the Tennessee has an enormous advantage over the Cumberland and Alabama.

THE RIVER CANALS ARE INADEQUATE, AND THEY ALREADY ADD TO THE OBSTRUCTIONS IN THESE GREAT RIVERS.

The canals on both rivers were planned and constructed for a depth of water that does a serious injustice to the commerce of the Ohio

and Tennessee rivers, as it is already developed. If adhered to, these rivers will be ultimately condemned as commercial highways.

The improvements that have been made have already reached the limit of usefulness, and they are, in fact, obstructions to a great volume of commercial values that remain dormant where it was created by nature, or it is so heavily taxed with railroad transportation that little profit is found in its further development.

Within a few years these canals will be enlarged in some of their dimensions to meet the growing demands of commerce or else they will become useless.

The history of the Erie Canal in New York, the Sault Ste. Marie Canal in Michigan, the Suez Canal—indeed, of every canal that has not already been destroyed by the competition of railroads—shows the necessity of increasing the capacity of all canals, as well as of railroads, to meet the demands of the growth of commerce.

A 12-foot channel in the Ohio and Tennessee rivers as the basis of all further improvement, to correspond with the depth of channel in the Mississippi River, applies to the main channels of those rivers and not necessarily to their smaller affluents. But the canals around the obstructions in those rivers are indispensable parts of their main channels, and they deserve the early and careful attention of the Government.

PRESENT LEGAL DEPTH OF TENNESSEE RIVER.

In Tennessee River, which nature has relieved from the shifting of ice and sand bars, the present depth of the channel as provided by law is 6 feet at Colbert Shoals. Five feet is the depth of water on the miter sills of the Muscle Shoals Canal.

In the Ohio River, which requires constant care and large expenditures to provide against these shifting obstructions, the depth fixed by law is 9 feet on the miter sills of the locks between Pittsburg and Morgantown on the Monongahela River.

NEW DEPARTURE.

This legislation on Government account as to the upper reaches of the Ohio River and the legislation, below set out, as to the central division of Tennessee River, on a contractual basis between the Government and private persons or corporations, virtually establishes the basis of 12 feet as the depth to be given in due season to all the canals and channels on both rivers.

The principle is also adopted that it is lawful and expedient that locks and dams may be constructed by private enterprise and capital, in consideration of the perpetual right to use the water power which they will produce. The success of this plan is already demonstrated in the cost of the dam to be constructed at Hales bar, below Chattanooga, as to which the committee will copy the act approved April, 1904, in an appendix (A A).

This new plan of cooperative work in river improvement is also applied, by acts of Congress, to the upper waters of the Cumberland and other rivers under varying contracts. This plan, or expedient, is founded upon the money value of the water power generated in the shoal places of many rivers that can be made navigable only by removing or controlling such obstructions.

For creating horsepower there can be no substitute for water power in respect of cheapness of production, the cost of maintenance, or the unfailing and perpetual use; and its superior value and convenience, when used in connection with electricity or compressed air in all stationary work, give to it a money value that is far above that of any mines of coal or other fuel for such purposes that would produce the same amount of power.

The human arm must, at last, prepare all fuel for use in generating power by steam, while the unfailing force of nature supplies this power perpetually and without cost.

We have reached the point of time in which the sedate consideration of the value of water power must prevail. It is already among the greatest actual reinforcements of the money resources of the Government, aside from taxation, in the improvement of the navigation of all our mountain water courses. This new departure has come to stay, and it is a grand step in our progress.

PRESENT DUTY OF THE GOVERNMENT AS TO TENNESSEE RIVER FROM KNOXVILLE TO PADUCAH.

The duty first to be performed, and the manifest necessity in respect of the navigation of Tennessee River, is to remove or submerge all obstructions between Knoxville and Paducah, so as to secure a depth of water across them of not less than 6 feet, to correspond with the depth of water on the miter sills of the canal lock at Colbert shoals.

This work of necessity and justice is demanded by the laws of the United States that fix the depth of water on the miter sills of the lock at Colbert shoals.

The depth of water on the miter sills of the canals and at other places on these rivers has reference only to the draft of the vessels that are to navigate them.

Twelve feet is assumed to be the maximum depth of channel on both rivers to answer the purposes of commerce in the distant future, while a depth of 6 feet is the minimum that is required for the present actual needs of that commerce, and a depth of 9 feet is the most moderate demand of justice.

It is due to justice that in the progress of deepening the channels of both rivers to 12 feet they should receive equal assistance from Congress.

TWELVE-FOOT LEVEL—ITS COST AND VALUE.

At first view it may seem that the deepening of the channel of Tennessee River from Knoxville to Paducah to 6, 9, or 12 feet is a venture that will require too great an expenditure to make its contemplation a question of any practical importance. So it seemed in 1862-1864 as to a transcontinental railroad line between San Francisco and Omaha. Yet that line was completed in a short time and with little ultimate cost to the Government.

Five great transcontinental lines have been added to the list in less than fifty years, and Mexico, at Tehuantepec, and Guatemala, Nicaragua, and Honduras are all at work building four other transisthmian railroad lines to connect the great oceans.

In the meantime we have paid a newly created government \$10,000,000 and a bankrupt French company \$40,000,000 for the Panama Railroad, with the privilege of expending three to five hundred million dollars in digging a canal which, when constructed, will destroy the Panama Railroad as a means of commercial transportation between the oceans, and will be a virtual loss of its value, which is not less than \$25,000,000.

The mere demands of commerce have thus committed the United States and our people and other governments to expenditures for transportation facilities than run up into several billion dollars, and "the end is not yet."

The United States, after all these expenditures by our own and other governments and peoples, plunges headlong into additional depths of unknown expenditure in order to find a cheaper line of transit between the great oceans and to gain the power to regulate the cost of overland transportation by rail through the only possible means, which is competitive transportation by water. Can any mind grasp the magnitude or resist the pressure of this demand of commerce for highways of transportation by water?

All the lines in existence and all that are in contemplation at present use steam power, generated by coal exclusively, as their motive power. The power of the winds is, so far, excluded from use, and coal is the sole reliance of all this mighty effort.

Tennessee River, with a 12-foot channel, can furnish coal to all these transcontinental roads south of Canada, and to the Isthmian Canal, their competitor and regulator, cheaper and in more abundant and certain supply from the stores laid up in the Appalachian Range, as far to the north as West Virginia and as far to the south as Alabama, than it can be supplied to them through any other highway of commerce.

It is equally accessible to a canal at Colon and to all the railways that cross the Mississippi and Missouri rivers.

The cost of a 12-foot channel in the Tennessee River is a negligible sum when compared with such expenditures in railway and canal construction and maintenance.

They can get their needed supply of motive power at all seasons and under all conditions from this river, to a great extent, and they will be compelled to seek their supply from this grand reservation of steam-generating fuel.

Nothing can defeat the fixed destiny of Tennessee River as the main channel through which this article of commerce must be transported to the seaboard and to the western watershed of the Mississippi River, and, therefore, no other water course is more valuable to the country.

The cost of a 12-foot channel from Knoxville to Paducah is inconsiderable when it is compared to these national benefits and necessities.

CANALS AROUND THE GREAT OBSTRUCTIONS ON BOTH RIVERS.

On Tennessee River there are three great levels or elevations caused by the crossing of three ledges of rock, one at Colbert shoals and another at Muscle shoals and the third in the mountain section of the river below Chattanooga.

From Colbert shoals to Paducah the river falls 0.374 foot per mile. From the head of Muscle Shoals canal to Colbert shoals the distance is about 60 miles, and the fall of the river is 2.73 feet per mile.

From Knoxville to Chattanooga the distance is 188 miles, and the fall per mile is 0.956 of a foot.

These great rock obstructions detain the water at these points and check its swift flow to the channel of the Mississippi, which would otherwise prevent all navigation. At low water the drain of the pools of deeper waters, now accumulated above these great natural dams, would convert them into swift and shallow currents. No navigation for commercial purposes would have been possible in any part of the Tennessee River in the absence of these great natural dams.

This is also true as to the ledge of rock that crosses Ohio River at Louisville, and its removal would drain the Ohio of its waters so rapidly that for a great distance it would become too shallow and swift for useful navigation.

These conditions create the necessity for maintaining these barriers at their present height, and for making the rivers above them navigable by means of locks and dams.

Where canalization or locks and dams are practicable they should be adopted in preference to cutting deeper channels through these great rock ledges and allowing the water an unobstructed course to lower levels.

CHATTANOOGA OBSTRUCTION.

A short distance below Chattanooga an obstruction is found across the river formed by bowlders that have come from mountain sides between which the river flows, forming a riprap dam that is about 600 feet in width, and is built up on a base rock until at low water it is covered only to the depth of 15 inches. The removal of this obstruction would drain off the waters at Chattanooga and for a long distance above until navigation for commercial uses would be practically destroyed.

HALES BAR.

A dam across Tennessee River at a point several miles below this riprap dam will be constructed, under the recent act of Congress, with a lock of sufficient height to give a depth of water of 35 feet across it.

There is no practicable ground around this obstruction in which a canal could be cut. This dam and its lock, when constructed, will cover every obstruction in the river to the depth of at least 9 feet as far as the crossing of the bridge of the Queen and Crescent Railroad, 5 miles above Chattanooga, and for a still greater distance. The removal of 3 feet from the top of three or four small intervening shoals, would give 12 feet of navigable water, for the distance of 40 miles, through the most difficult part of Tennessee River, if not for a much increased distance.

This splendid scheme of cooperation between the Government and private enterprise, opens the inquiry as to the extension of a 12-foot channel to Knoxville and from Hales bar to Lock A of the Muscle Shoals Canal. The committee agree that no rough or overdrawn conjecture is made in the suggestion that a 12-foot channel can be had,

with decided economy and advantage over the present system, for this distance, by putting in dams and locks of 15 to 30 feet in height at suitable locations.

These locks and dams, estimated at \$1,000,000 each, which is probably twice the actual cost, would be eagerly taken by private capital, and constructed for the use of the water power, as is being done at Hales bar.

CANAL FROM BROWNS ISLAND TO FLORENCE.

This part of the river has peculiar features, that require separate examination and treatment.

It covers a distance of 31 miles, of which 18 are included in the Muscle Shoals Canal, which is separated into two sections by an open river channel of about 8 miles. This section is on the southern border of the river. At Locks A and B the canal is $3\frac{1}{2}$ miles long. The section on the northern border of the river is $14\frac{1}{2}$ miles long from Lock No. 1 to Lock No. 9.

From Lock No. 9 to Florence is about 7 miles. In this reach of the open river an obstruction, called the Little Muscle Shoals, dams up the water in a deep pool that extends about 1 mile below Lock No. 9.

On Little Muscle shoals a series of islands extends parallel to the northern shore of the river, from this pool to Florence, with short intervals between them. Between this chain of islands and the northern bank of the river is a shallow, swift channel about 6 miles long, through which steamboats ascend to Lock No. 9 of the canal.

This channel is about 120 feet wide and, at low water, its depth in several places is about 16 inches. This channel, which is the only means of access to Lock No. 9 by steamboats, is a heavy handicap on the ascending navigation of Tennessee River, and needs improvement.

The depth of water on the miter sills of the canal is 5 feet, but in the channel just described and in the open stretch of river between Lock No. 1 and Lock B, the depth of water over shoal places is frequently less than 2 feet.

To get a depth of 12 feet at all points between Florence and Browns Island, the work required is a low dam and lock across the steamboat channel at Florence, not exceeding 15 feet in height, and a lock and dam at the best point between Lock B and Lock No. 1, probably not to exceed 15 feet in height.

The water on the miter sills of the 11 locks on the canal can be deepened to 12 feet by raising the dams and locks to the proper height on the present structures.

The cost of this addition to the capacity of the locks is very slight as compared with the benefits of the navigation they will afford.

The extent and value of the water power between Browns Island and Florence will be discussed under a head that relates to the general subject of the water power of the Tennessee River and its principal affluents.

This water power, if it is disposed of with the care it deserves, will be an asset of great value to the Government. It can not be doubted that a dam at Florence, to extend from Pattons Island to the south bank of Tennessee River, will furnish a power that is equal to the

dam that will be constructed at Hales bar, below Chattanooga; and its location in the center of industry that is already concentrating many millions of dollars through private enterprise, where the only motive power is furnished by coal mined in the Birmingham coal fields, will make this water power as valuable as any in the United States.

The committee present the following suggestions of an able and experienced man who has spent fifteen years in practical work on Tennessee River, in the central and western divisions, as to the probable work needed to give a channel between Knoxville and Paducah at the depths of 6, 9, and 12 feet, which they adopt as being entirely practicable and as presenting plans for the improvement of the river that are based on its actual condition ascertained by Government surveys and meet the requirements of the present and future:

FIRST SECTION—PADUCAH TO RIVERTON.

Six-foot depth.—The project for this depth is by dredging, which is now under way. The estimate of 1898 showed the necessary dredging to be 653,819 cubic yards, fully half of which amount has since been done.

Nine-foot depth.—The "open-river" method will probably be found best and most economical for this depth, and a large part of the work so done will be of use when changed from 9 to 12 foot depth.

Twelve-foot depth.—This would probably require additional locks and dams. The total fall is 79 feet. If the dams are of the fixed type, four would suffice for the whole reach; if of a movable type, ten would be required.

SECOND SECTION—RIVERTON TO FLORENCE.

Six-foot depth.—The project now being worked out includes a lateral canal around Colbert and Bee Tree shoals, which is in an advanced state of completion. Above Colbert Shoals Canal only dredging and regulating works will be needed, the cost of which will be small.

Nine-foot depth.—This would be possible by regulation, but as locks and dams would be necessary to accomplish the next stage (12 feet) in development it would be better to adopt locks and dams for the 9-foot project. If of the fixed type, one lock and dam would do. If of the movable type, two would be required.

Twelve-foot depth.—This can be reached by adding to heights of structures for 9-foot channel.

These observations are extended to other sections of the river as far as Knoxville in the following synoptical form:

SECTION FROM FLORENCE TO HALES BAR.

Little Muscle Shoals, Florence to Lock 9.—Improvement of this stretch will undoubtedly be made by canalization of the river. If done for the improvement of navigation alone, it will probably be accomplished by two additional locks and dams. If done by a combination of channel improvement and water power development, one lock and dam would probably be resorted to. Passage from one stage of development to another would be done by increasing heights and dimensions of structures, so as to provide for channels of 9 or 12 foot depths.

SECTION FROM LOCK A TO HALES BAR.

The distance is 143 miles; fall, 59 feet. While this reach could be improved by regulation up to 6-foot depth, to carry the improvement farther would require locks and dams; so that it would be better to start with that method in the beginning. If of the fixed type, three locks and dams would suffice. The movable type would require seven or eight; that is, if the lifts adopted on Ohio River be used.

NAVIGATION OF TENNESSEE RIVER.

SECTION FROM HALES BAR TO CHATTANOOGA.

With a small amount of dredging at the upper end of the pool, a channel of 12 feet will be obtained by the construction of the lock and dam to be built at Hales bar.

SECTION FROM CHATTANOOGA TO KNOXVILLE.

The distance is 188 miles; total fall, 180 feet. Improvement for all three depths of water in channel (6, 9, and 12 feet) would be by locks and dams. If they are of the fixed type, 9 locks and dams would do it; if of the movable type, it would require 24. It is likely that the former would be adopted, as it is expected that the dam now being built by private enterprise at Hales bar will create such a demand for similar privileges at other places on the river that most of the river's improvement will be done in a similar way. That dam being permanent and 35 feet high, no navigation for boats and rafts in high water would be practicable. In high or low water the use of the lock would be necessary.

Movable types of dams are usually designed for small heads of water, and the water power so developed would be so irregular that water-power schemes in connection with them would not be sought after.

The cost per lock and dam (movable type) on Ohio River is given, in round numbers, as \$1,000,000, and it is probable that the cost per foot of lift would be about the same whether fixed or movable dams were used.

It might be well, in this connection, to consider the possibility of Muscle Shoals Canal being done away with and locks and dams being substituted therefor, the latter to be built by private enterprise for water-power purposes.

In these comprehensive and accurate notes the actual situation on the entire river up to Knoxville is summarized, and a plan of permanent improvement, at either of three depths of channel, is set forth that is practicable at a low cost. The saving that will be made by a permanent, systematic, and progressive improvement of the navigation of the river will be the wisest economy. It will cause the wasteful expenditures, which are largely the result of local jealousies, to disappear, and capital, population, and enterprise will rapidly respond to the encouragement thus given by a settled policy of the Government.

A million dollars, average, for locks and dams on Tennessee River is a great sum in the aggregate, and is most likely twice the actual cost. But at \$1,000,000 each they are not half the sum of the subsidies given by the Government to a single transcontinental railroad. When these locks and dams are paid for by private parties, as nearly all of them will be in consideration of the value of the water power created by them, the movement takes such a form of public and private benefit to all concerned that its blessings to the whole country are beyond computation.

The following tables show the total amount of appropriations and expenditures on Tennessee River and on the Ohio and Cumberland rivers from the beginning up to date, including all expenditures for the operation, repairs, and maintenance of Government works on these rivers and their affluents.

River.	Appropriation.	Expenditure.
Tennessee	\$7,170,866.75	\$5,515,241.19
French Broad	97,000.00	94,866.67
Clinch	54,500.00	52,472.49
Hiwassee	51,000.00	56,522.00
Holston	5,000.00	3,523.90
Total	7,377,866.75	5,702,626.25

Statement of projects, appropriations, and expenditures for improving Ohio River and certain of its tributaries.

[Furnished to the committee by the Chief Engineer of the Army.]

Locality and project.	Total amount appropriated to June 30, 1905.	Total amount expended to June 30, 1905.
Ohio River: General open-channel improvement, Pittsburg to mouth, to secure 6-foot depth.....	^a \$6,974,557.50	^b \$6,008,617.43
Ohio River: Construction of Lock and Dam No. 37, at Fernbank, Ohio, to secure 6-foot depth.....	550,000.00	40,944.09
Ohio River: Operating snag boat.....		^c 460,071.83
Monongahela River, W. Va.: Construction of Locks and Dams Nos. 8 to 15; least depth $5\frac{1}{2}$ feet on sills of No. 8; $5\frac{3}{4}$ of No. 9, and 7 feet of Nos. 10 to 15 ^d	1,819,363.86	1,694,299.94
Monongahela River, Pa.: Locks and Dams Nos. 2, 3, 5, and 6 (rebuilding Locks and Dams 2 and 3; enlargement and improvement of Lock 6; providing certain accessory structures at Lock 3, and certain floating plants; acquisition of land at Dam 6; certain improvements at Dam 5 and 6) ^d	1,049,367.00	^d 560,281.41
Monongahela River, W. Va., and Pa.: Operating and care.....		^e 1,694,384.17
Pittsburg Harbor, Pa.: Dredging; raising old riprap dam across Brunot Island, Ohio River; removing abandoned structures; marking harbor lines, etc.....	135,662.90	127,336.97
Ohio River: Operating and care of Dams Nos. 1 and 6.....		^e 464,975.16
Ohio River: Construction of Locks and Dams Nos. 2 to 7 to secure 6-foot depth ^f	4,018,000.00	3,267,662.85
Ohio River: Pool No. 6, improving channel in upper approach to Lock No. 6.....	^g 20,800.00	
Allegheny River, Pa.: Construction of Locks and Dams Nos. 1 to 3 to secure 7 and 8 foot depths.....	1,132,000.00	1,120,042.81
Allegheny River, Pa.: Operating and care of Locks and Dams Nos. 1 to 3.....		^e 48,674.49
Allegheny River, Pa.: Open-channel improvement.....	265,000.00	259,996.32
Ohio River: Constructions of Locks and Dams Nos. 8, 11, 13, 18, 19, and 26, between Pennsylvania State line and Cincinnati, to secure 6-foot depth ^h	2,126,800.00	764,414.73
Little Kanawha River, W. Va.: Open-channel work and construction of lock and dam to secure 4-foot depth.....	378,604.10	214,387.04
Little Kanawha River, W. Va.: Operating and care of lock and dam.....		^e 38,687.46
Kanawha River, W. Va.: Open-channel work and construction of locks and dams to secure 6-foot depth.....	4,273,766.16	4,174,526.88
Kanawha River, W. Va.: Operating and care of locks and dams.....		^e 656,986.50
Gauley River, W. Va.: Open-channel work to secure 2-foot navigation ⁱ	15,000.00	14,761.05
Elk River, W. Va.: Open-channel work to provide bateau navigation ⁱ	30,500.00	30,259.12
Muskingum River, Ohio: Operating and care of locks and dams.....		^e 1,557,287.25
Guyandot River, W. Va.: Open-channel work ^j	22,689.90	22,689.90
Big Sandy River, W. Va. and Ky., including Tug and Levisa forks: Lock and dam construction and open-channel work to secure 6-foot depths.....	1,296,704.88	1,016,392.58
Big Sandy River, W. Va. and Ky.: Operating and care of locks and dams.....		^e 26,862.89
Kentucky River, Ky.: Lock and dam construction and open-channel work to secure 6-foot depth ^k	2,988,150.98	2,666,054.22
Kentucky River, Ky.: Operating and care of locks and dams.....		^e 1,235,642.96
Ohio River at the Falls, at Louisville, Ky.: Enlargement of Louisville and Portland Canal; improving Indiana Chute; rock excavation, etc. ^l	^m 1,677,795.06	^m 1,582,543.39
Purchase price and cost of improvement prior to 1884.....	2,900,000.00	2,900,000.00

^a Does not include an allotment of \$56,000 reserved from appropriation of act of March March 3, 1905, for defraying expenses of board appointed under said act to survey Ohio River with reference to canalization. Includes funds applied to construction of Davis Island dam.

^b Includes expenditures applied to construction of Davis Island dam.

^c Expenditures under permanent annual appropriation provided by acts of September 19, 1890, and June 3, 1896.

^d Locks and Dams 1 to 7 were acquired from the Monongahela Navigation Company at a cost of \$3,769,073.88, of which \$3,751,615.46 was the award in condemnation proceedings.

^e Expenditures under permanent indefinite appropriation, act of July 5, 1884, for operating and care of canals, etc.

^f The river and harbor act of March 3, 1905, provides for increasing the project depth to 9 feet in the pools belonging to dams 2 to 6.

^g Allotment from appropriation of \$300,000, act of March 3, 1905, for general improvement of Ohio River.

^h Pursuant to the river and harbor act of March 3, 1905, expenditure of funds on Locks and Dams 19 and 26 is contingent upon further action of Congress.

ⁱ Work suspended.

^j Work has been suspended on this stream since the fiscal year 1900.

^k Five locks and dams on this river were acquired from the State of Kentucky in 1880.

^l For details see p. 484, Annual Report for 1904.

^m Does not include about \$2,900,000, which was expended in acquisition, improvement, etc., of the canal prior to 1884.

Statement of projects, appropriations, and expenditures for improving Ohio River and certain of its tributaries—Continued.

Locality and project.	Total amount appropriated to June 30, 1905.	Total amount expended to June 30, 1905.
Louisville and Portland Canal, Ky.: Operating and care.....		^a \$1,937,941.38
Wabash River, Ind. and Ill.: Open-channel work and construction of lock and dam below Vincennes ^b	\$715,000.26	713,638.54
Open-channel work above Vincennes.....	95,500.00	95,238.42
Operating and care of lock and dam.....		^c 26,374.09
White River, Ind.: Open-channel work to secure 2-foot depth.....	120,000.00	119,296.18
Green River, Ky., above mouth of Big Barren River, construction of locks and dams to secure 6-foot depth, and Nolin River, Ky., open-channel work ^d	^e 365,673.20	^e 265,052.66
Green and Barren rivers, Ky.: Operating and care of locks and dams.....		^c 1,147,595.78
Bough River, Ky.: Open-channel work and construction of lock and dam ^f	105,500.00	103,175.11
Bough River, Ky.: Operating and care of lock and dam.....		^c 6,604.99
Cumberland River, Tenn. and Ky.: Below Nashville—Open-channel work and lock and dam construction to secure 6½-foot depth.....	900,974.05	862,841.58
Above Nashville—Open-channel work and lock and dam construction to secure 6½-foot depth.....	2,019,470.85	1,802,271.57
Total.....	33,329,262.74	

^a Expenditures for operating and care made by acts of March 3, 1881, and July 5, 1884.

^b Least depth on sill, 3½ feet.

^c Expenditures under permanent indefinite appropriation, act of July 5, 1884, for operating and care of canals, etc.

^d Provided for by river and harbor act of March 3, 1905.

^e Does not include \$135,000 expended in acquisition of locks and dams on Green and Barren rivers.

^f Least depth on sill, 4½ feet.

The great discriminations in the appropriations and expenditures between Ohio River and its affluents and Tennessee River and its affluents, to whatever other causes and influences the same may be attributable, are not due to their respective capacity for making rich and permanent contributions to commerce, domestic or foreign.

Nor are such wide discriminations due to the difficulties or the proper expense required to make these water courses equally navigable at any given depth of water. Nor are they due to the characteristics of the population of the watershed of either river, or to the topography, or healthfulness, or water supply, or the forests, or the fertility of the lands in these areas, or to the beauty of these regions, respectively, for there is no country in the world more beautiful than the valleys, hills, and mountains that are intersected and watered by Tennessee River and its many affluents, great and small.

The committee are not in search of the reasons for the neglect of Tennessee River by Congress in the past history of the country, but they are impelled by a sense of duty to the whole country to present the facts that appeal to Congress for a just, wise, and national policy that will give to the Tennessee River its rightful position as the foremost of the tributaries of the Mississippi River as a contributor to the wealth and commerce of the country.

These facts are incontrovertable and are established officially in the reports of the engineers and scientific explorers who have examined and surveyed these regions.

Common interest and justice to all the people demand the systematic and impartial improvement of all the navigable water courses in the order of their commercial precedence, especially because they are the only great leverage that can control the cost of transportation by common carriers on land and water.

The apparently large expenditures on Ohio River and its tributaries

are due in considerable degree to the want of system in their improvement and as a certain result of fitful and inadequate appropriations. But these sums are really trifling when compared with donations of lands and money to great railroads across the continent and in all the public-land States and Territories to promote their construction. These donations have been made to companies of private persons and to corporations largely through combinations of influence over Congressional legislation, while the rights and necessities of all the people have been neglected or ignored.

The time has arrived when this policy will be changed in order to preserve the natural and political rights of the people.

VII.

MUSCLE SHOALS WATER POWER AND VALUE TO THE COUNTRY.

In addition to the great volume of water power afforded by other parts of Tennessee River and its affluents, which may be justly said to equal any river system in reach of the industry and commerce of the world, by water transportation, the Muscle shoals has power and advantages which are of extraordinary value that deserve separate examination.

Between Lock No. 1 and Florence, Ala., is a continuous rock formation, with a fall of 84 feet, for a distance of 21 miles. Excluding for the present the part of this barrier above Lock No. 1, the Muscle shoals proper and the Little Muscle shoals below Lock No. 9 of the canal (which are a part of this rock formation), the depth of water on the shoals, at the lowest tides in the river, forbid any navigation that requires more than 15 inches of water.

This great river spreads out over these shoals to an average width of more than a mile and is intercepted by islets and projections of rock, between which it flows in swift currents. The highest of the islets is about 15 feet above the surface of the water and are covered in the highest stages of river floods. The projections of rock would probably average 3 feet above the lowest stage of water.

The general surface of the water on these shoals is comparatively smooth and of even depth in its levels across the river and is about the same, with no deep fissures to interfere with the building of dams, at any location that may be selected. The islets and projecting rocks can be taken into the structure of the dams at a considerable advantage in the cost of such works.

This section of Tennessee River is through a fertile and beautiful upland, presenting on both shores bluffs of rock of strong texture that afford very extensive and excellent quarries of stone for all structural purposes, while the rocks for the rougher work of dam construction are abundantly supplied in the bed of the river. Sand and clay are easily in reach of these shoals by water or land transportation.

At Clifton, on Tennessee River, some 40 miles below Florence, ledges of rocks are found that are of great value for the production of Portland cement. This cement is also produced in the cheapest and best form on the affluents of Alabama River, within 150 miles of Muscle shoals, by railroad and will soon be manufactured in vast quantities.

To quote the language of one of the ablest of American engineers, who has examined and surveyed these shoals for private parties, "There is no place in the world where greater advantages are to be found for the harnessing of water power for the uses of industry, or where there is greater power awaiting development, within reach of the seaboard by water and rail transportation, than at Muscle shoals."

Another able and practical man, who has been employed for fifteen years in Government works at these shoals and at other places along the whole line of Tennessee River, states his opinion of its value for water power in terms quite as strong and suggests the improvement of certain localities as being of great benefit to navigation in connection with the value of the power that they would develop.

These suggestions are well worthy of careful examination, as they relate to changes in the canal that will become indispensable within a few years.

Shoal Creek, a rapid and strong current, flows into the river between Locks No. 6 and 8. A steel viaduct spans this creek at its mouth, which is 900 feet in length, 60 feet wide, and 5½ feet deep, which is of sufficient capacity to float any boat that can navigate the canal. This viaduct has been severely injured at one time and is always endangered by heavy floods in Shoal Creek, and is a constant cause of anxiety in respect of the navigation of the canal, which means the navigation of Tennessee River.

The steel plates that form the trunk of the viaduct are already weakened by oxidization in many places. In those places the rust has eaten away one-half the thickness of the plates within the period of about fifteen years since the viaduct was constructed. As no way is known to prevent such decay, it will result in the destruction of the plates inside of twenty years, when the cost of the repairs would equal the original cost of the structure.

A dam at Lock No. 9 across Tennessee River, of about 30 feet height, would dispense with Locks Nos. 7 and 8, including the viaduct across Shoal Creek, and would give 9 feet of water on the miter sill of Lock No. 6. The depth of water could be increased to 12 feet by raising the dam at Lock No. 9 to the required height, and this depth could be supplied up to Lock No. 1 by a wing dam at the intake of the canal at that lock.

Other improvements between Locks No. 1 and No. 6 to admit of a depth of 9 or 12 feet on the miter sills of all the locks are needed even now to supply a depth of 5 feet on the miter sill of Lock No. 6, and the cost of additional improvements to get a greater depth of water in the canal would be almost inconsiderable when compared with the value of the additional facilities of navigation that are really indispensable to the commerce of the country.

These suggestions are wise and timely, and are based upon the practical operation of the Muscle Shoals Canal since it was opened, and the defects in the plan that have been exposed by a costly experience.

The necessity for one or two additional dams and locks between Lock No. 9 and Florence is obvious and indispensable.

The number and location of these necessary improvements of navigation and the question of their availability as generators of power for the supply of industries operated by private parties should be speedily determined by official surveys to be made by the Government.

The water power at Florence is a subject of immense importance to those engaged in all descriptions of manufactures in respect of the capacity for generating power and its cost and constant supply. The channel for navigation being along the right bank of the river, and separated from the larger channel on the left bank by Patton Island and other smaller islands which can be used exclusively for water-power development, this part of the river may require different

treatment from that part between Lock No. 9 and Lock No. 1, to be determined by careful surveys.

This section of the Muscle shoals is $14\frac{1}{2}$ miles long, and the fall is 85 feet.

The most accurate and authentic account of the various important features of the Muscle shoals, with reference to the capacity for generating power by constructing dams across them, is given in the following extracts from the report of F. H. Newell, Chief Engineer, to the Director of the United States Geological Survey, dated February 27, 1904, as follows (58th Cong., 2d sess., H. Doc. 761):

SHOALS IN TENNESSEE RIVER NEAR FLORENCE.

In Tennessee River, in the vicinity of Florence, Ala., are several shoals capable of the development of power. The compiler has brought together the data regarding these, his intention being not to discuss the manner in which the immense water power of these shoals can be developed, but to give some idea of its magnitude and the possibility of its utilization.

The shoals are a succession of cascades amid many islands, in a river bed varying in width from a half mile to 3 miles. The numerous channels thus formed are very irregular in fall and direction. The difference between high and low water is only 5 or 6 feet, corresponding to a rise of 50 feet at Chattanooga. Beginning at Browns Ferry, 12 miles below Decatur, Ala., the river has the following falls:

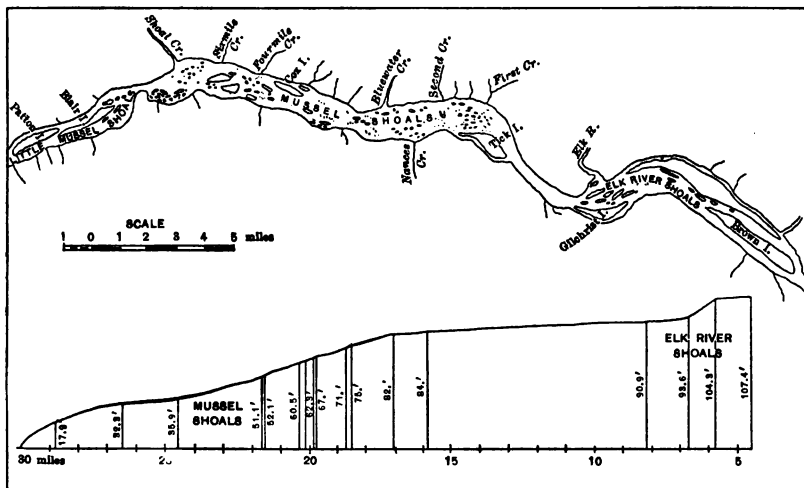


FIG. 9.—Map showing shoals in Tennessee River near Florence.

From Browns Ferry to the mouth of Elk River the fall is 26 feet in 11 miles. This is known as "Elk River shoals." Its most precipitous part is at the lower end, where there is a fall of 16.5 feet in about 4 miles.

From the mouth of Elk River to the head of Muscle shoals, a distance of 5 miles, there is a fall of only 2 feet.

From the head of Muscle shoals to Bainbridge the fall is 85 feet in 17 miles, and is known as "Muscle shoals."

From Bainbridge to Florence the fall is 23 feet in 7 miles, and is known as "Little Muscle shoals."

From Florence to the head of Colbert shoals the fall is 3 feet in 11 miles.

From the head of the Colbert shoals to Waterloo the fall is 21 feet in 6 miles.

The total fall from Browns Ferry to Waterloo is, therefore, 160 feet in a distance of 57 miles. Sixteen miles of the distance, however, has a fall of only 5

feet, leaving a fall of 155 feet in the 41 miles that cover the four shoals mentioned. The shoals are really more precipitous than the foregoing figures would indicate. For instance, 84.6 feet of the fall at Muscle shoals is in a distance of 14 miles.

The bed rock at Elk River shoals is Carboniferous limestone; that of Muscle shoals is a hard siliceous rock of dark color and flinty structure.

Assuming that tributaries entering the river below Chattanooga can safely supply all of the water needed for lockage, the discharge at Chattanooga can be used in estimating the water power of these shoals, which are about 200 miles below Chattanooga by river, and of which the drainage area is more than 7,000 square miles greater than that at Chattanooga.

Estimated minimum net horsepower of Tennessee River in Alabama on turbines realizing 80 per cent of the theoretical power.

Locality.	Fall.	Minimum net power in driest years.	Minimum net power in average years.
	<i>Feet.</i>		
Elk River shoals	26	15,600	30,550
Muscle shoals	85	51,000	99,875
Little Muscle shoals	23	13,800	27,025
Colbert shoals	21	12,600	24,675
Total	155	93,000	182,125

The foregoing table assumes that the total fall can in each case be utilized. While this assumption is not correct, it stands as an offset to the assumption that the water supply available will be as low as the minimum discharge at Chattanooga, 200 miles above. The drainage area above Chattanooga is 21,418 square miles, while the drainage area above the shoals under consideration is about 29,000 square miles. It may therefore safely be assumed that the actual power available for development at the shoals is greater than that shown by the table.

The foregoing statements of fall and distance are from a report by Mr. William B. Gaw, chief assistant engineer, U. S. Army, 1868, and the map and profile are from drawings prepared under the direction of Lieut. Col. J. W. Barlow, U. S. Engineers, 1890.

In this distance of 14½ miles, seven dams, 2 miles apart, can be constructed between Lock No. 1 and Lock No. 9, on the Muscle shoals proper.

If these dams are only 15 feet high they would each give 7,285 horsepower daily at low water and 14,266 horsepower at the annual minimum average flow of Tennessee River.

Apparently there is no physical reason why dams may not be less than 2 miles apart, such as flooding the machinery operated by dams farther up the river in flood times. In the greatest floods the water rises not more than 6 feet on these shoals at the times when the rise at Chattanooga is as much as 50 feet. The intervals between the dams need not be greater, as a rule, than the distance required to prevent machinery from being flooded by the back water from dams below them.

Taking 99,875 horsepower as the daily capacity of the river at Muscle shoals in average years and computing its value at the annual cost of horsepower generated by steam at Ensley or Birmingham, Ala., and the saving in the cost of waterpower at Muscle shoals almost exceeds belief.

The cost of horsepower generated by steam at the places where the coal mines are in sight of the engines and with the best equipment for good results is an average of \$30 per annum for each horsepower.

At this rate the 51,000 horsepower furnished at Muscle shoals daily, at the lowest stage of water, would cost \$1,530,000 per annum, and the 99,875 horsepower furnished at the annual average stage of water would cost \$2,996,250 if it was produced by steam in the Birmingham district, which is the best in the South.

This estimate of cost includes only the generation of horsepower by steam and its application to the machinery to be operated.

Computing the cost of horsepower created by water power at Muscle shoals, the cost of the dams in the river covers the entire expense except the application of the power to the machinery to be operated, and it is a liberal statement of such cost to make it equal to like expenditures in the use of power generated by steam.

The cost of seven dams that would create daily 99,875 horsepower, even at \$1,000,000 each, the horsepower so created would be estimated at a fair rate of annual interest on \$7,000,000 and the loss, if any, in the repairs necessary to keep the dam in good order. The water, which is the actual power, is supplied free of cost by the hand of nature.

If the rate of interest on the investment and all possible wear and tear of the dam and the machinery to transmit the power into manufacturing establishments should be estimated at the extravagant rate of 10 per cent per annum, the annual cost of 99,875 horsepower, generated and transmitted at Muscle shoals by seven dams, would be the gross sum of \$700,000.

While the annual cost of generating and transmitting 99,875 horsepower at the great coal centers named would be \$2,990,250, the saving in favor of the water power would be 60 per cent.

The relative cheapness of the horsepower generated by water power at Muscle shoals that is in easy reach of capital is so much actual wealth that these shoals will yield to the country when they are brought into service as generators of power.

This saving to the country is practically perpetual, and its value will increase continuously with every coming year. These figures, derived from official and authentic sources, are presented by the committee as a mere outline sketch of the value of Muscle shoals, intended to provoke further inquiry and to call the attention of Congress to the pressing duty of having an accurate survey of Muscle shoals and all the area between Lock No. 1 and Florence, Ala.

Attracted by the convenience of excellent facilities in the location and the cheap and abundant material for boat building, and for the manufacture of all machinery, tools, implements, and material needed in public works in river improvements, there has grown up at Lock 6 an establishment for such purposes, which is the nucleus of a much more extensive and useful development of Government works at that place.

Because of the cheap and unfailing supply of water power, the security against invasion of flood waters and river drift, the access by water to the great forests that furnish an ample supply of the best timber, and to iron and steel works of great capacity located on the banks of Tennessee River within 10 miles of Lock 6 and at Chattanooga and other places on the river, there is nowhere to be found a more eligible site for a boat yard or other manufactories that are necessary for public works within the watershed of Mississippi River.

Mr. Walter S. Winn, assistant engineer, employed in the work on Tennessee River for fifteen years, has had the personal supervision of the Muscle Shoals Canal for four or five years. In reply to a note from the chairman of the committee, Mr. Winn gives the following description of this location and of the excellent work and wise economy that has been accomplished at Lock No. 6:

MUSCLE SHOALS CANAL.

FLORENCE, ALA., R. F. D. No. 5, September 7, 1905.

Senator JOHN T. MORGAN,
Bailey Springs, Ala.

SENATOR: Complying with your request, I give below a brief history of Muscle Shoals Canal, its shops, the scope of the work done therein and their susceptibility of enlargement.

Muscle Shoals Canal was first built by the State of Alabama in the years 1831-1836, being assisted to that end by a grant from Congress of 400,000 acres of United States lands, proceeds from sale of which were to be applied principally to improvement of Muscle shoals and Colbert shoals. The canal was 14½ miles long, 60 feet wide, and had 17 locks, each 120 feet long between sills and 32 feet wide, with an average lift of 5 feet. Its cost was about \$700,000. The building of the canal was a success, but because of the limitations to navigation to the shoals immediately above and below the canal, which had not been improved, the canal was but little used, and in 1837, no appropriation having been made for its maintenance, it was abandoned and fell into ruin. The wooden lock gates decayed, embankments went to pieces under the action of rains and floods, the canal trunk filled with mud and grew up in willows and cottonwoods.

In 1875 the General Government began its reconstruction on plans based upon surveys made in 1871-72. The new canal was declared open to navigation November 10, 1890, and has been in use ever since. It is 14½ miles long and has nine locks, with a total lift of 85 feet. The locks are 60 feet wide, 300 feet long between sills, and have a depth of 5 feet on lower sills, except at its extremities, where mistakes were evidently made in fixing low-water plane too high. The canal trunk is from 70 to 150 feet wide and 6 feet deep.

From 1875 to 1879 work was carried on under contracts with three contractors, but in the latter year that system was entirely abandoned and the remainder of the work was done on the hired-labor plan.

Under the same project a canal around Elk River shoals, 1½ miles long, with two locks of the same dimensions as those on the Muscle Shoals Canal was built. The two canals cost, in round numbers, \$3,000,000. Though they are separated by 8 miles of open-river navigation the two canals are under the same management, the same appropriation for maintenance, and both are embraced in the title "Muscle Shoals Canal."

During the construction of the canals the work was divided into several sections, each having a headquarters where were located crude shops for repairing tools and appliances. Upon completion headquarters were established at Lock 6, and what of the tools and machines in the old section shops were worth it, were brought to the new headquarters and installed there to begin the work of providing for the canal's maintenance. Permanent quarters for the canal operatives, storehouses, and shops were to be built and the structures of the canal kept in good order.

The works on the canals to be kept up by the shops are, at present, as follows: Eleven locks with their gates, valves, footbridges, maneuvering appliances, etc.; 1 bear-trap drift sluice; 3 small masonry drift sluices; 6 masonry dams at mouths of creeks and branches; 3 paved weirs, aggregating 2,500 feet in length; a steel aqueduct 60 feet wide, 5½ feet deep, and 900 feet long; a railroad 16 miles long, including sidings, and equipment for same, consisting of 2 locomotives, 14 cars, 2 hand cars, and a velocipede; 40 buildings; 130 acres of ground; 18 miles of canal trunk and embankments; 2 steamboats; 1 snag boat; 4 barges, skiffs, etc. The shops designed for the maintenance of the foregoing are a sawmill and planing mill, woodworking shop, blacksmith shop, machine shop, foundry, and dry dock, and their equipment is as follows:

SAWMILL AND PLANING MILL.

The power of these mills is furnished by a 55-horsepower turbine. The equipment consists of a No. 2 DeLouch sawmill with a 60-inch circular saw, edging saw, and table, swing cut-off saw and a planing machine that will dress lumber up to 6 by 24 by 40 inches. The sawmill was put into operation in 1895, and since that time has sawed 1,671,900 feet of lumber. Secured in this way the lumber has cost the Government about \$11 per thousand feet. Its market value was not less than \$25 per thousand. In the same time the planing mill has dressed about a million feet of lumber at a cost of about \$2.25 per thousand. Besides the actual saving in the cost of manufacturing the lumber, the advantage of being able at any time to cut lumber to dimensions needed without having to wait for bids to be taken for furnishing it and the tedious delays in getting it on the ground must be considered.

WOODWORKING SHOP.

This shop is run by a 22-horsepower turbine and is equipped with turning lathe, small planing machine, woodworker, circular rip saw, boring table, sliding table, cut-off saw, and scroll saw. Fixtures for all except the first two named are homemade. They are all great labor-saving devices under any conditions, but doubly so in this instance, considering the fact that the power to run them costs nothing. The advantages of water power over steam power which, under all circumstances, are well marked, are greatly magnified in this instance where, from the nature of the work, the demands on the machinery are spasmodic. Occasionally the turbine is kept busy all day, again it may be necessary to use some machine only a few minutes a dozen times a day, or the power may not be turned on for several days at a time. If steam power were used it would be necessary to keep a fireman constantly on hand and steam raised ready for use. With water power one turn of the wheel and the machinery is in motion and another, when the work is done and all is stopped, no fire to be banked nor boiler to be cooled down nor operative to be kept on hand.

It may be well to state in this connection that the full power of the turbine is by no means consumed in this shop, and part of its power could be transmitted to the machine shop with great saving in the long run. An electric generator could be attached to the turbine to furnish electricity to run one motor in the woodworking shop and another in the machine shop. The power of the wheel is sufficient for both purposes.

MACHINE AND BLACKSMITH SHOP AND FOUNDRY.

The power of these shops is furnished by a small engine of 10 indicated horsepower. The blacksmith shop has two forges, with blast furnished by a fan propelled by the above engine. It is equipped with a full line of small tools. If much heavy work were required of it a steam hammer would probably be needed.

The foundry has a small furnace for melting brass and a Whiting cupola having a capacity of about 1 ton per hour, and capable of making a single casting weighing about 1,000 pounds. All iron castings used in repairs of structures on the canal, boat machinery, hoisting engines, locomotives, cars, etc., have been made in this foundry, except a few of such intricate pattern that it was cheaper to obtain them from factories that had the patterns on hand than to make a pattern, and a few of such large size that the machine shop could not furnish them. Under the latter head the only ones recalled were the valves for Lock A, at which lock balance valves were last year substituted for the lifting valves first put in that lock. The foundry was put into service in 1898. No record was kept of its annual output until the past three years. During that time it has averaged 22,162 pounds of castings per annum, at a cost of 1.63 cents per pound.

The machine shop is equipped with 1 lathe having 14-foot bed, 24-inch swing (the swing has been increased to 36 inches by cast-iron blocks to raise head and tail stocks) and cutting from 1 to 36 threads per inch; 1 lathe having 7-foot bed, 12-inch swing, and cutting from 1 to 108 threads per inch; 1 drill press having 16-inch swing; 1 shearing and punching machine; 1 planer 20 inches wide and 4-foot stroke; 1 sharper; 1 drill grinder. The shop has done all the machine work for repairs to canal structures, boats repaired in dry dock, locomotives, cars, etc., except as to a few pieces which were larger than the

capacity of the machines. The shop employs one machinist and apprentice regularly, and an extra machinist when an unusually large amount of work is on hand.

DRY DOCK.

As soon as the canal was open for navigation boats for its maintenance began to accumulate, and it became necessary to provide ways and means for repairing them. At first the lighter ones were pulled out on the bank of the canal and the heavier ones were docked in the aqueduct. This method was neither safe for the aqueduct nor satisfactory as a place to repair boats. Repairs were delayed by the passage of boats, which necessitated the aqueduct's being filled. In February, 1897, a dry dock, 60 feet wide, 175 feet long, and 7 feet deep, was built on the mainland side of the canal about 500 feet west of Lock 6. The gate to the dock is 40 feet wide, and it will, therefore, chamber a boat 175 feet long and of 40-foot beam.

The first boat placed in the dock was the U. S. steamer *Long*, which is a unit of the fleet used in improvement of Tennessee River above Chattanooga. Since that time, U. S. steamers *Colbert*, *McPherson*, and *Kingman*, dredge *Alabama*, 7 barges, 1 derrick boat, 1 quarter boat, and a flatboat have been rebuilt; 1 snag boat, 2 barges, and 1 derrick boat have been built new, and all the craft used in improvement of the river from Chattanooga to Paducah, and most of that above the former city, have been in the dock for repairs. The following shows the number of times the dock has been occupied by different classes of boats: Five steamboats, 20 times; 3 dredges, 10 times; 2 naphtha launches, 3 times; 1 snag boat, 3 times; 5 derrick boats, 6 times; 18 barges, 32 times; 5 quarter boats, 5 times; 3 pump scows, 6 times. The dock has therefore been used 85 times.

IN GENERAL.

The canal is an ideal place for building and repairing boats and machinery.

(1) It is an attractive spot, to which mechanics seem glad to come to work. No trouble has ever been experienced in getting all the workmen desired at standard wages.

(2) Water power, without cost, is available for several times the amount of work at present turned out, and could be increased 100 per cent at but moderate cost. The sawmill and planing mill could as well manufacture 1,500,000 feet of lumber per annum as the 77,591 feet it turned out last year. The other shops are capable of the same expansion. The available water power could be extended to the metal-working shops with a great saving in cost of their output.

(3) No better site for a dry dock can be found on an inland river. The fluctuation of the river between extreme high and extreme low water is only about 10 feet. While, it is true, that gives backwater in the dock, at its present location, at high stages of the river, requiring leakage to be pumped out, it is not subject to backwater more than three months in the year. Then there is a better location for a dock on the pool above Lock 6, where it would have perfect immunity from high water. The location being on the same pool as the sawmill and planing mill would be a considerable advantage. The present dock was constructed on temporary lines, having timber walls, and it will have to be built over in a year or two. The change of location could be made when rebuilding becomes necessary.

(4) The climate at Lock 6 will give as many working days in a year as any point that could be selected. There is neither the rigorous winters of the North nor the extreme heat of points farther south to contend with.

(5) Oak, poplar, gum, ash, and all other woods generally used in the construction of boats through this section, except long-leaf pine, are in abundance on Tennessee River and its tributaries, whence logs could be cheaply floated to the mills. Lock 6 is close and of easy access to the long-leaf pine belt. So far, it has not been necessary to go out of wagon-hauling distance of the canal for timber and the supply is still fairly good.

(6) The shops can easily be expanded by installation of the necessary apparatus to do larger and more varied work. Steel hulls for boats, boilers, machinery, and tools could be made.

(7) Work done in the boat yards and shops at Lock 6 costs about the same as that secured by contracts at other points, but is superior in both material and workmanship. The material is carefully inspected and only high-class mechanics employed to do the work.

(8) The canal would be a safe harbor for boats waiting to be repaired or to be sent away after repairs.

Summing up, the situation at Lock 6 seems to offer many attractive features in favor of the establishment of a general headquarters for building and repairing Government boats and machinery used on the Tennessee, Ohio, and Mississippi rivers and their tributaries.

Very respectfully,

W. S. WINN,
U. S. Assistant Engineer.

This letter shows how much has been accomplished by the thoughtful and careful use of the water power of the Muscle shoals, and the necessary success of a considerable increase to be made gradually, but in a proper system, in the further development of this useful establishment.

A further suggestion is made by Mr. Winn that he does not refer to in his letter. It is, that a channel of 100 yards in length, leading from the river into the canal a short distance below Lock No. 5, can be constructed at a very small cost that will more than quintuple the water power now available at Lock No. 6 for driving this machinery. He explains in his letter that there is now a large excess of power at Lock No. 6 that could be used if the work to be done so required, but the addition of the water power to be taken from the river by making a small dam at an island that is conveniently situated at that point would so increase the present available power at Lock No. 6 as to provide for more than ten times the machinery that can now be successfully operated at that place.

These facts and suggestions demonstrate the necessity for an immediate survey of this special feature of the water power of the Muscle shoals with a view to the enlargement of the capacity of these important works. No argument can be needed to prove this necessity, and the facts, which the growth of practical experience has already developed, prove that a great economy in public expenditure will be the result if Congress will lend a helping hand to this valuable enterprise.

The immense amount of material of special size, strength, and durability, both of wood and metal, and of machinery, tools, implements, boats, dredges, and pile drivers required by the Government in the works on the Mississippi River and its tributaries, requires care and wise forecast as well as liberal expenditures in creating the needed establishments for such purposes at the best localities. This proposition can not be rationally disputed, and the committee feel warranted in expressing the belief that no better location for such works can be found within the watershed of the Mississippi River than that at Lock No. 6 on the Tennessee River.

Almost without assistance from the Government in the way of appropriations, this location has established its own precedence in this very important line of public service. Among the inducements it affords, the beauty and healthfulness of the country at Lock No. 6, mentioned by Mr. Winn in his letter, is an admirable and very attractive feature, and a strong invitation to the permanent residence of the best classes of laborers and mechanics.

For the purposes of more complete description of the Muscle shoals, the committee present the following excellent map, prepared by Col. J. W. Barlow in 1890, marked "Appendix B."

For the reasons stated above the committee dissent from the opinion

of Major Newcomer, as on pages 3 and 4 of his report, in Exhibit B, as to the further improvement and enlargement of the plant operated by the Government at Lock No. 6 of the Muscle Shoals Canal. They insist that it is a matter of real importance that such works should be improved and enlarged, and that it is quite easy and economical to get a full supply of water power at that place at all seasons of the year.

The committee submit herewith as Appendix D a letter from Capt. H. Burgess, Corps of Engineers, in charge of the Louisville and Portland Canal at Louisville, on the Ohio River, addressed to Mr. C. W. Holbrook, secretary of the committee, which gives the full history of that important work.

The Government was owner of stock in this canal and shared in its income for several years, when it purchased all the stock, and since that purchase it has operated the canal and has removed all charges for tolls, and large sums have been expended in its improvement.

The committee also submit a chart, marked Appendix E, which shows the relative accessibility to tide water of the Tennessee River coal and iron fields and those of the Ohio River; and also a table which shows the navigable length, the water supply, and the appropriations made for each river in the watershed of the Ohio and Tennessee rivers. This chart is instructive as showing the care of the Government, heretofore, of these great twin rivers.

All of which is respectfully submitted.

JOHN T. MORGAN.
E. W. CARMACK.
LEE S. OVERMAN.

APPENDIX A.

[PUBLIC—No. 165.]

An Act To enable the Secretary of War to permit the erection of a lock and dam in aid of navigation in the Tennessee River near Chattanooga, Tennessee, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be, and he is hereby, fully authorized and empowered to grant permission to the city of Chattanooga, Tennessee, or to a private corporation or company, or to individuals, as provided in section five of this bill, to build and construct a lock and dam across the Tennessee River at "Scott Point," near Chattanooga, Tennessee, under his direction, supervision, and control, and in accordance with and conformity to the plans and designs made by Major Dan C. Klingman, an engineer of the United States Army, in pursuance of an act of Congress passed on March third, eighteen hundred and ninety-nine, with such changes and modifications as the Secretary of War may direct: *Provided,* That the said contracting municipality or parties shall purchase and pay for all lands on either side of the river that may be necessary to the successful construction and operation of said lock and dam, including flowage rights and rights of way for ingress and egress from public highways, and deed the same to the United States, and make all excavations, erect all stone, concrete, and timber work, furnish all materials of every character, and pay for all labor employed in the construction of said lock and dam, and give said lock and dam to the United States completed, free of all cost, expense, claims, or charges of any kind whatsoever, except for expenses connected with the preparation of plans and the superintendence, as provided in section five of this Act, and further excepting the cost of the lock gates and ironwork and machinery necessary to operate the lock when completed, which shall be furnished by the United States.

SEC. 2. That the said municipality, corporation, company, or individuals undertaking the construction of said work shall begin the building of said lock and dam within eighteen months from the passage of this Act, and the same shall be completed within four years from the date of beginning the construction, the right being reserved to the United States to enter on the construction of said lock and dam if deemed advisable at any time before the work is commenced by said contracting parties; or if begun and not carried on in strict accordance with the directions of the Secretary of War, then the United States may assume the further construction and completion of said work at its option, the cost of such further construction and completion to be paid by the said contracting municipality, corporation, company, or individuals.

SEC. 3. That the deed to the United States to the land to be purchased and donated to the same, as mentioned in the first section of this Act, shall be executed and delivered within twelve months after the passage of this Act; and, further, that the Secretary of War shall determine from time to time whether the work is being properly done, and may require an increase in force to be employed by the contractor so as to force the work to completion within the limit mentioned in the Act.

SEC. 4. That in consideration of the construction of said lock and dam, free of cost to the United States except as provided in section one of this Act, the United States hereby grants to the municipality, corporation, company, or persons constructing said lock and dam under the provisions of this Act such rights as it possesses to use the water power produced by said dam, and to convert the same into electric power or otherwise utilize it for a period of ninety-nine years: *Provided*, That it or they shall furnish the necessary electric current while its or their power plant is in operation to move the gates and operate the locks and to light the United States buildings and grounds, free of cost to the United States: *And provided further*, That the plans for the necessary works and structures to utilize said water power shall be approved by the Secretary of War, and that nothing shall be done in the use of the water from said dam or otherwise to interfere with or in any way impede or retard the proper and complete navigation of the river at all times, nor in any way to interfere with the use and control of the same by the United States for the purposes of navigation: *And provided further*, That the Secretary of War is hereby authorized to prescribe regulations to govern the use of the said water power and the operations of the plant and force employed in connection therewith; and no claim shall be made against the United States for any failure of water power resulting from any cause whatever.

SEC. 5. That it shall be the duty of the Secretary of War in contracting for the erection of the said lock and dam to give the preference, option, or first right to contract to do said work to the city of Chattanooga, Tennessee, but if said city of Chattanooga shall fail within four months from the passage of this Act to formally notify the Secretary of War of its intention to construct said lock and dam and to enter into contract to do so, then to C. E. James and J. C. Guild, residents of Chattanooga, Tennessee, their heirs and assigns. In case of failure on the part of said C. E. James and J. C. Guild, residents of Chattanooga, Tennessee, their heirs and assigns, for a further period of eight months to formally notify the Secretary of War of their intention to proceed with the construction of the lock and dam as herein provided, then it shall be lawful for the Secretary of War to contract with any private corporation, company, firm, or persons for the construction of said lock and dam on the terms and in the manner herein provided: *Provided*, That the Secretary of War may require the contracting party to execute a bond, with proper sureties, before the commencement of the work in such amount as he may consider necessary, not exceeding one hundred thousand dollars, to insure the commencement, prosecution, and completion of the work herein authorized and compliance with the terms, conditions, and requirements of this Act, and in case of failure to comply with the requirements of said bond the said contracting party shall forfeit to the United States the full amount thereof: *Provided further*, That the plans, including specifications and drawings for the work, shall be prepared at the expense of the United States, under the direction and subject to the approval of the Secretary of War and the Chief of Engineers, United States Army, by the officer of the Corps of Engineers, United States Army, having under his charge the work of improving the Tennessee River, who shall at the expense of the United States maintain a suitable force of inspectors upon the work to see that the plans and specifications are strictly carried out, and such conditions

or safeguards as the Secretary of War and the Chief of Engineers may deem essential to securing proper results shall be made a part of the contract. The expense for plans as well as for the maintenance of the force of inspectors herein referred to shall be paid from the amount appropriated for preliminary examinations, surveys, contingencies, and so forth, made in section two of the river and harbor Act of June thirteenth, nineteen hundred and two.

Sec. 6. That in the event the city of Chattanooga undertakes the erection of said lock and dam the Secretary of War shall extend the time provided herein for beginning the work on the same for a period not exceeding twelve months from the passage of the enabling act that the general assembly of the State of Tennessee may pass at its next regular session, enabling said municipality to undertake said work, if the same be necessary; and in the same event he shall extend the time for the completion of said lock and dam twelve months.

Sec. 7. That the right is expressly reserved in the United States to revoke by Act of Congress the rights, privileges, and benefits conferred by this Act; but in the event of such revocation the United States shall pay to the municipality, corporation, company, firm, or persons who may erect said lock and dam under the provisions of this Act, as full compensation, the reasonable value, exclusive of the franchise hereby conferred, of all properties erected and lands purchased by them necessary for the enjoyment of the benefits conferred upon them by the provisions of this Act, such value to be determined by mutual agreement between the Secretary of War and the owners of said properties, and in case they can not agree, then by proceedings instituted in the United States circuit court for the condemnation of said property, such proceedings to conform as nearly as may be to the laws of the State of Tennessee in respect of condemning land for the right of way for railroad purposes: *Provided*, That to insure compliance with the terms of the contract or of this Act, or to protect the interests of navigation, the Secretary of War shall have power at any time, before or after the completion of the work, to order a suspension of all privileges granted by this Act: *And provided further*, That compliance with such order of suspension may be enforced by the injunction of the circuit court of the United States exercising jurisdiction in the district in which the work is situated, and proper proceedings to this end shall be instituted by the Attorney-General upon request of the Secretary of War.

Sec. 8. That nothing in this Act shall be construed as in any way interfering with the exclusive jurisdiction over and control by the United States of the Tennessee River and the lock and dam therein to be erected for the purpose of navigation, nor as repealing or modifying any of the provisions of law now existing in reference to the protection of navigation.

Approved, April 26, 1904.

[PUBLIC—No. 6.]

An Act To amend an Act approved April twenty-sixth, nineteen hundred and four, entitled "An Act to enable the Secretary of War to permit the erection of a lock and dam in aid of navigation in the Tennessee River near Chattanooga, Tennessee, and for other purposes."

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Act of Congress approved April twenty-sixth, nineteen hundred and four, entitled "An Act to enable the Secretary of War to permit the erection of a lock and dam in aid of navigation in the Tennessee River near Chattanooga, Tennessee, and for other purposes," be, and the same is hereby, amended by inserting in section one, line seven, after the words "Scott Point," "near Chattanooga, Tennessee," and before the word "under," the following: "or at such other point or place in the mountain section of said river below Scott Point as the Secretary of War may approve."

Approved, January 7, 1905.

APPENDIX B.

[Senate Document No. 173, Fifty-eighth Congress, third session.]

TENNESSEE RIVER, AT MUSCLE SHOALS CANAL.

Letter from the Secretary of War, transmitting, in response to a resolution of the Senate of January 24, 1905, certain information regarding the improvement of the Tennessee River at the Muscle Shoals Canal.

FEBRUARY 24, 1905.—Referred to the Committee on Commerce and ordered to be printed.

WAR DEPARTMENT,
Washington, February 23, 1905.

SIR: In response to Senate resolution dated January 24 ultimo, calling for certain information regarding the improvement of the Tennessee River at Muscle Shoals Canal, I have the honor to transmit herewith copy of a report from the district engineer officer, Maj. H. C. Newcomer, Corps of Engineer, dated February 16 instant, together with map and tracing referred to by him.

The Chief of Engineers, United States Army, concurs in the views expressed by Major Newcomer.

Very respectfully,

WM. H. TAFT,
Secretary of War.

HON. WILLIAM P. FRYE,
President of the Senate pro tempore.

ENGINEER OFFICE, UNITED STATES ARMY,
Chattanooga, Tenn., February 16, 1905.

GENERAL: I have the honor to submit the following report in compliance with your indorsement of January 26, 1905, on Senate resolution of January 24, 1905, calling for certain information with reference to the lands and water power at the Muscle Shoals Canal. A small lithograph map showing the general situation at the canal, and a tracing on much larger scale showing the lines of the present and old canals, with adjacent lands, are transmitted herewith, marked "A" and "B," respectively.

The first paragraph of this resolution reads as follows:

Resolved, That the Secretary of War inform the Senate of the condition of the Muscle Shoals Canal, on the Tennessee River, with reference to the right of way for said canal, and as to any tracts of land along the line that are necessary to be acquired by the Government for the security or convenience of operating or maintaining the same.

The United States undoubtedly owns the right of way for the upper section of the canal, having purchased the necessary land for

this purpose, as shown on map B. The ownership of the lands occupied by the lower section of the canal is not so clear, but it is held that practically all private titles to these lands have been extinguished either by the United States or by the State of Alabama.

The lands along this section that have been actually purchased by the United States are shown on map B, and these portions, of course, clearly belong to the United States. The remaining portions of the right of way are thought to be the property of the United States, either by adverse possession for a sufficient term of years or as belonging to the right of way of the old canal built by the State under the authority of Federal law and controlled by the State for many years prior to the time when the United States assumed charge of the work and rebuilt it.

By act of May 23, 1828, the United States granted the State of Alabama 400,000 acres of public land to aid it in improving the Tennessee River at Muscle shoals and Colbert shoals in accordance with plans to be approved by the President of the United States. Under this law, and in accordance with an act of the legislature, approved January 15, 1830, the State undertook the work through a "board of Tennessee canal commissioners," who were, among other things, empowered to acquire the right of way through private lands, and to pay all damages that might result to such lands by the construction of the canal, which was planned to give passage around the Big Muscle shoals.

Certain of the public lands referred to above were reserved for a time for canal purposes, and then sold in conformity with an act of the State legislature approved January 15, 1831. The deeds for these lands embodied the provisions of the act which required—

that the purchasers thereof shall permit the canal commissioners to take, free of any charge, any part thereof for the use of the said canal, or to take and use free of any charge, any timber, stone, gravel, or earth, or convert any stream of water thereon to the use of said canal, free of any charge or expense to said canal whatever.

The lands abutting on the lower section of the canal, on which these canal privileges were reserved by deed are indicated by yellow margin on map B.

The old canal around Big Muscle shoals was begun in 1831 and opened in 1836. It is to be presumed that the canal commissioners acquired the necessary right of way through private lands and paid all damages to such lands that may have resulted from the canal construction. The canal soon fell into disuse, but the State continued to exercise control over it until the United States took possession and began rebuilding it in 1875. It was opened to navigation in its present form in 1890.

In rebuilding the canal there were some departures from the old line. Several suits for damages on account of land occupied or injured by the present work have been instituted against the United States. Some of these were discontinued and others settled by the purchase of the land in question. There are no such suits, however, known to this office pending against the United States at the present time.

If, as is believed, the right of way for the canal is now rightfully in the possession of the United States, there are no tracts of land along

the line that are now deemed "necessary to be acquired by the Government for the security or the convenience of operating or maintaining the same."

The question of acquiring the private lands, amounting to about 341 acres, that lie between the river and the lower section of the canal, has been under consideration for some time. Mr. W. S. Winn, the assistant engineer in charge of the canal, recommends their purchase on the following grounds:

First. To afford dumping ground for the material that must periodically be dredged from the canal trunk.

Second. To afford borrow pits from which to get earth for stopping leaks, repairing breaks, strengthening embankments, etc.

Third. To settle questions of disputed ownership.

Fourth. To avoid all further claims for damages arising from private ownership of these outside lands.

These undoubtedly represent advantages of some value, but after considerable deliberation I am not convinced that they are of sufficient importance or urgency to warrant the purchase of all of these outside lands at the present time. It is probable that these needs, should they require additional ground, can be satisfied by the purchase of limited portions of these tracts. No present action is recommended.

The second paragraph of the Senate resolution reads as follows:

Second. And that he will advise the Senate of his opinion as to the best method of acquiring such lands—whether by process of condemnation or by purchase—and whether a commission is necessary for that purpose.

If at any time it should be considered advisable to acquire additional land for the canal, it would be better to do so by purchase in case the price demanded is reasonable and a good title can be thus secured. Otherwise the land should be acquired by process of condemnation. In neither case would it appear to be necessary to have a commission authorized for the purpose, as the War Department can take the necessary steps under authority granted by the act of April 24, 1888.

The third paragraph of the Senate resolution reads as follows:

Third. And that he will inform the Senate (first) whether the water power at Lock 6 on said canal is being usefully employed for supplying power for the machinery at said lock that belongs to the United States; and (second) whether it will be useful to the public service to increase such machinery for the purpose of being employed in the construction or repair of boats, dredges, and the preparation of materials or machinery for use in Government work for the improvements on the Tennessee River or its tributaries.

The first question is answered in the affirmative and the second in the negative. The water power at Lock 6 is used to run the machines in the carpenter shop, sawmill, and planing mill. By this means much of the lumber required for repairs to the Government buildings and boats is manufactured from logs at a cost considerably below the market value of such material. The tools in the machine shop are run by steam power. This shop is not conveniently located with reference to the water power, except for electric transmission, and this would require the installation of an electric power generating plant. The expense of reorganizing the shop on this basis would probably be out of all proportion to the saving in operation that

might be effected for the small amount of power that is used. Moreover, at certain stages of the river the available supply of water from the canal is practically exhausted by the present plant. In short, the present facilities for making repairs appear to be ample for the present needs of the Government works of improvement on the Tennessee River and its tributaries.

The fourth paragraph of the Senate resolution reads as follows:

Fourth. And that he inform the Senate whether the War Department has granted, or sanctioned, or approved any grants, licenses, or privileges for the use of the water power of the Tennessee River, on any part of the Muscle Shoals, to any persons or corporations, and that he state the terms, conditions, and extent of such grants, privileges, or licenses, and the authority under which the same have been made.

This office has no information that the War Department has ever taken any such action as that described in this paragraph, unless its action should be so regarded in one instance, when, under date of August 17, 1904, I was authorized by the Department to inform the owners of the land on both sides of Turkey Island Chute (nearly opposite Lock 6) that the War Department would interpose no objection to their constructing a dam across this chute, provided it was so built as not to obstruct or injure navigation in any way.

The only real grant of the above character known to me is that made by Congress to the Muscle Shoals Power Company by act of March 3, 1899, which is as follows:

AN ACT granting to the Muscle Shoals Power Company right to erect and construct canal and power stations at Muscle Shoals, Alabama.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the consent of Congress is hereby given to the Muscle Shoals Power Company, a corporation created and organized under a charter granted by the legislature of the State of Alabama, its successors or assigns, to erect, construct, operate and maintain inlet and outlet races or canals and a power station or stations at a point or points at or near the Muscle Shoals in Tennessee River, and to make such other improvements as may be necessary within said limits for the development of water power and transmission of the same: *Provided*, That the constructions hereby authorized do not in any way interfere with the Muscle Shoals Canal or with navigation of said river: *Provided further*, That until the plans and location of the works herein authorized, so far as they affect the interests of navigation, have been approved by the Secretary of War, the improvements shall not be commenced or built, and the Secretary of War is authorized and directed to fix reasonable charges for use of said power.

SEC. 2. That unless the work herein authorized be commenced within one year and completed within three years from the date hereof the privileges hereby granted shall cease and be determined.

SEC. 3. That the right to alter, amend, or repeal this act is hereby expressly reserved.

The times for beginning and completing the work under this law have been successively extended by acts of June 6, 1900, March 1, 1901, and February 18, 1903. According to the last act the company must begin work before February 18, 1905, but it has not yet submitted plans to the Secretary of War for approval, as required by the law.

The fifth and last paragraph of the Senate resolution reads as follows:

Fifth. And that he will inform the Senate of his opinion whether it is advisable to create a commission, and as to how it should be constituted, to examine

into and report upon all or any of the matters referred to in these resolutions, and especially as to the disposition that should be made of the water power furnished by the shoals of the Tennessee River, above mentioned; and what legislation, if any, Congress should provide for the proper adjustment and regulation of the rights of the United States and of the State of Alabama, and also of the riparian proprietors and the owners of islands in the Tennessee River at those localities.

In view of what precedes, I have no suggestion to offer of any work to be undertaken by a commission. I am not aware that the United States has any right or interest in the water power that can be developed at the Muscle Shoals, aside from its control over the waterway for purposes of navigation and its ownership of the canal property.

Very respectfully, your obedient servant,

H. C. NEWCOMER,
Major, Corps of Engineers.

Brig. Gen. A. MACKENZIE,
Chief of Engineers, U. S. A.,
Washington, D. C.

APPENDIX D.

UNITED STATES ENGINEER OFFICE,
ROOM No. 425, CUSTOM-HOUSE,
Louisville, Ky., September 18, 1905.

SIR: In response to request contained in your letter of the 14th instant I have the honor to furnish the following information concerning the Louisville and Portland Canal:

HISTORY OF THE CANAL.

The canal was originally constructed by a private corporation, acting under a charter granted by the Kentucky legislature in 1825 and subsequent acts of the same body extending the time for completion and increasing the capital stock. It was completed and the first boat passed through it December 22, 1830. At that time there were three combined lift locks, each with a lift of about 8½ feet, a width of 50 feet, and length of 200 feet. The width of the canal proper was from 64 to 68 feet at normal stages of the river. There was no dam at the head of the canal.

The United States became a stockholder in the corporation in 1826, and gradually increased its holdings until all of the outstanding stock and bonds passed into its possession.

In 1860 an enlargement and extension of the canal, which included new locks, was begun under the corporate management and resulted in the width of the canal being increased to 90 feet, with three basins or passing places, and the construction of two new combined lift locks, with a total lift of about 26 feet. Each of the chambers of the new locks has a width of 80 feet and an available length of 350 feet. The new locks were opened to navigation February 6, 1872. Both the older and the newer locks were built of stone and had timber gates, which latter were operated by hand-power capstans and winches. Subsequent to the Government's assuming full charge of the canal and its operation steam power was provided for operating the gates of the newer locks.

The United States assumed charge of the work of completing the extension and enlargement of the canal and the construction of a dam across the river at its head, subsequent to an allotment of funds for that purpose in 1868, but the operation of the canal, i. e., the passage of traffic through it, and its maintenance in repair remained under control of the corporate management until June 11, 1874, on which date the entire control of the canal, including its operation, maintenance, etc., was assumed by the United States, pursuant to the act of Congress of May 11, 1874, which provided that the canal should be held "free of all tolls and charges except such as are necessary to pay the current expenses of said canal and keep the same in repair." Tolls were entirely abolished after midnight July 1, 1880, and since that date the expense of operation and maintenance of the canal has been borne directly by Treasury funds made available by the act of March 3, 1881, and the indefinite appropriation for "Operating and care of canals and other works of navigation," act of July 5, 1884.

The enlargements made since the Government assumed full control

include the widening of the canal between the new locks and the older locks, a distance of about 1,000 feet, so as to make the width of the canal between those points about 210 feet.

At the head of the canal an enlargement is now in process of construction under the existing project for "Improving Falls of Ohio River at Louisville, Ky." This latter enlargement is described as follows: Beginning at a point on the northerly side of the canal 725 feet below the railroad bridge at Fourteenth street, the width of the canal is abruptly increased from 90 feet to 210 feet. This latter width is then gradually increased through a distance of nearly 2,800 feet to 325 feet at the head of the canal proper, at which point the enlargement is expanded into a capacious basin or harbor 1,200 feet wide and practically parallel to the Kentucky shore. This latter enlargement is not yet completed.

The older set of locks, not being adapted to present requirements of navigation, were made to accommodate (since 1897) an automatic gate built for the purpose of causing, when desired, a current through the canal, and thus scouring out a vast quantity of deposit that otherwise would have to be removed by dredging.

The improvements made by the Government were effected by a combination of the contract and hired labor plans in construction work, and the purchase of material by formal contract, circular notice, or oral agreement, whichever was found to be most economical and advantageous to the United States at the time the expenditures were made.

The total cost of the improvements, so far as described above, since the Government assumed full control of the canal, is as follows:

Enlargement between old and new locks.....	\$133,000.00
Automatic gate.....	6,050.00
Enlargement at head of canal (incomplete) approximate cost as estimated	1,450,000.00
Total	1,583,050.00

The total cost of work done by the corporation is as follows:

Expended by the canal company on original canal.....	\$1,019,277.09
Expended by the canal company on subsequent improvements and construction	120,000.00
Expended by canal company for enlargement of canal.....	1,825,403.00
Total.....	2,964,680.09

The total cost to the United States is as shown below:

Original stock.....	\$233,500.00
Appropriations, etc., for enlargement and extension of original canal	1,463,200.00
Canal bonds paid	1,172,000.00
Deduct dividends paid to United States by the canal company....	257,778.00
Cost to United States.....	2,610,922.00

Expended subsequently.

For enlargements, etc., since assuming full control (approximately).....	\$1,589,050.00
For maintenance, care, and operation to July 1, 1905.....	1,937,941.38
Total.....	6,137,913.38

PRESENT WORKS UNDER MAINTENANCE.

The present works under maintenance include about 125 acres of land, the canal and locks, dry dock, automatic gate, movable dam at head of canal, 3 drawbridges across the canal and locks, 6 lock engine houses, with machinery therein, residence and office for assistant engineer, stone machine shop and boiler house, stone and brick blacksmithshop, stone and brick power house, stone and brick storehouse, frame carpenter shop, planing and saw mill, 1 towboat, 3 dredges, 6 mud scows, 4 barges, frame coal bin, branch office at head of canal, and canal walls, slopes, revetments, etc.

The machinery in the machine shops—sawmill and wood planing mill—is operated by steam. The work done is entirely for repairs to the various structures, floating plant, etc. No foundry is maintained, rough castings from patterns owned by the United States are purchased and finished in the canal shops, as is the bar iron, steel, lumber, etc. The cost of preparing or finishing such material is much less than is charged for similar grades or class of work in private shops, there being no expense for profit, insurance, etc. However, the greatest advantage is derived from being able to make the needed repairs at once, rather than await the convenience of crowded shops and experience the loss of service of the floating plant or other machinery.

The material used in the shops is ordinarily purchased under competitive bids from the lowest bidder, and comes from dealers in Louisville, Ky., New Albany, Ind., Jeffersonville, Ind., Cincinnati, Ohio, Pittsburg, Pa., Columbus, Ohio, St. Louis, Mo., Chicago, Ill., and other central markets. The coal is supplied principally from the Pittsburg market. The shop facilities are used for other than canal repairs, and when so used the expense is paid from the appropriation for which the work is done.

The dry dock at the locks of the Louisville and Portland canal will accommodate vessels not exceeding 225 feet in length and 54 feet beam. It is used for the construction and repair of floating plant owned by the Government, and when not needed for such use is available for use by private parties at very reasonable rates, which were established many years ago. The boats, both Government and private, that have been repaired on this dock were from the Mississippi, Ohio, Kentucky, Green, Wabash, Cumberland, and Big Sandy rivers. The dock is in excellent condition, and could not well be enlarged or improved, except at a cost far too great for the advantages that would result.

Very respectfully,

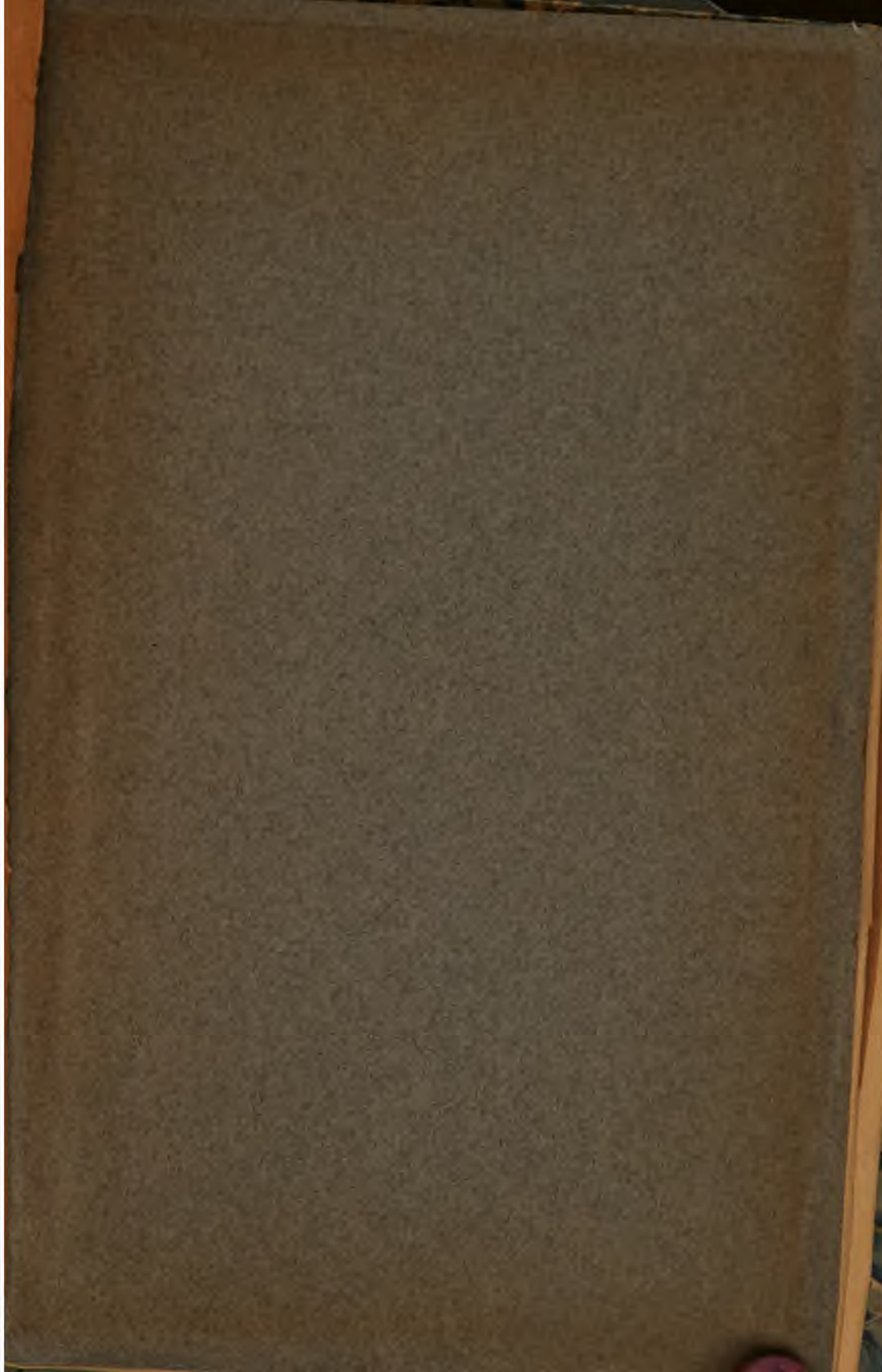
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Captain, Corps of Engineers.

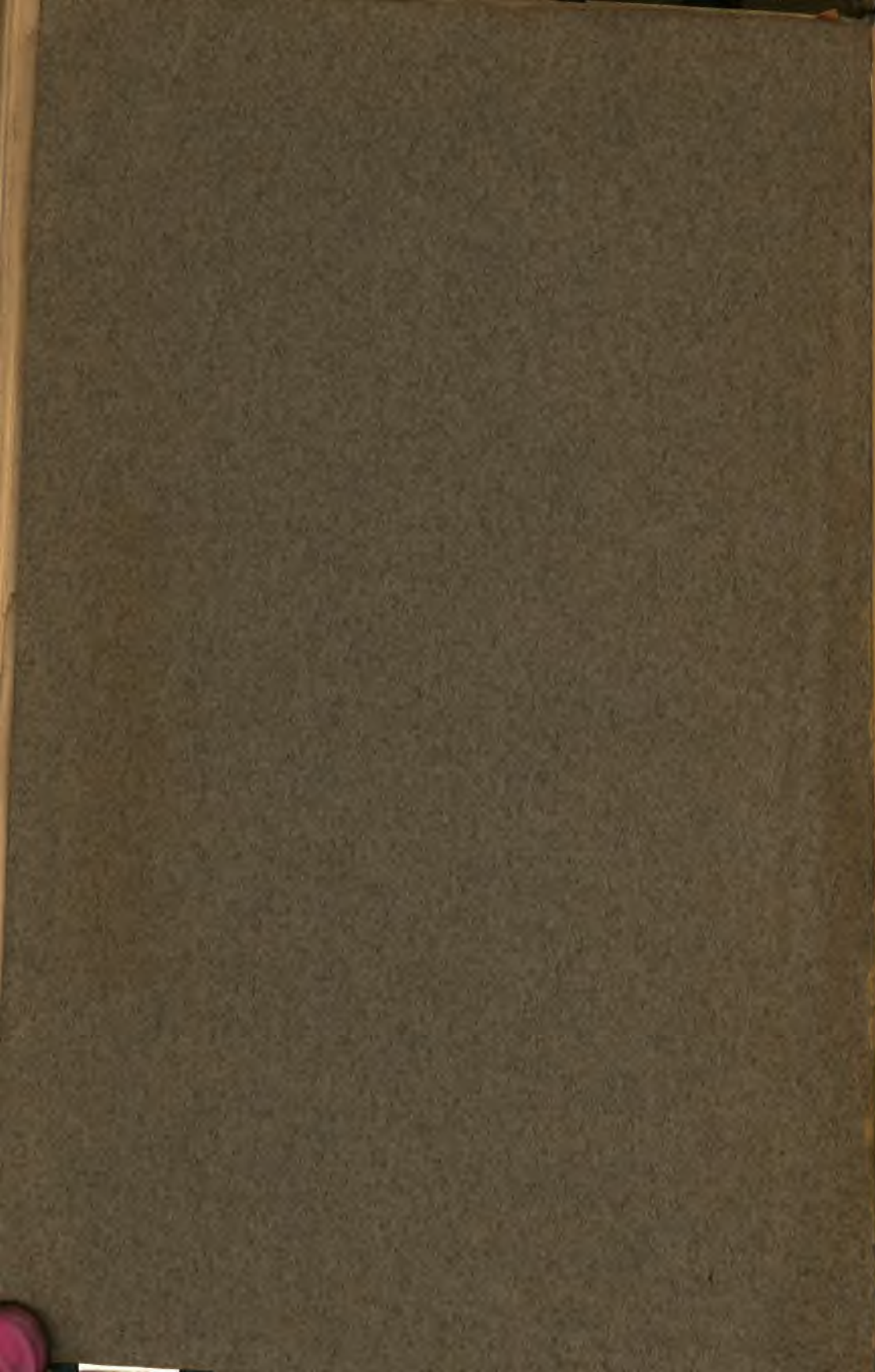
Mr. C. W. HOLBROOK,
Secretary Select Committee United States Senate,
Bailey Springs, Ala.

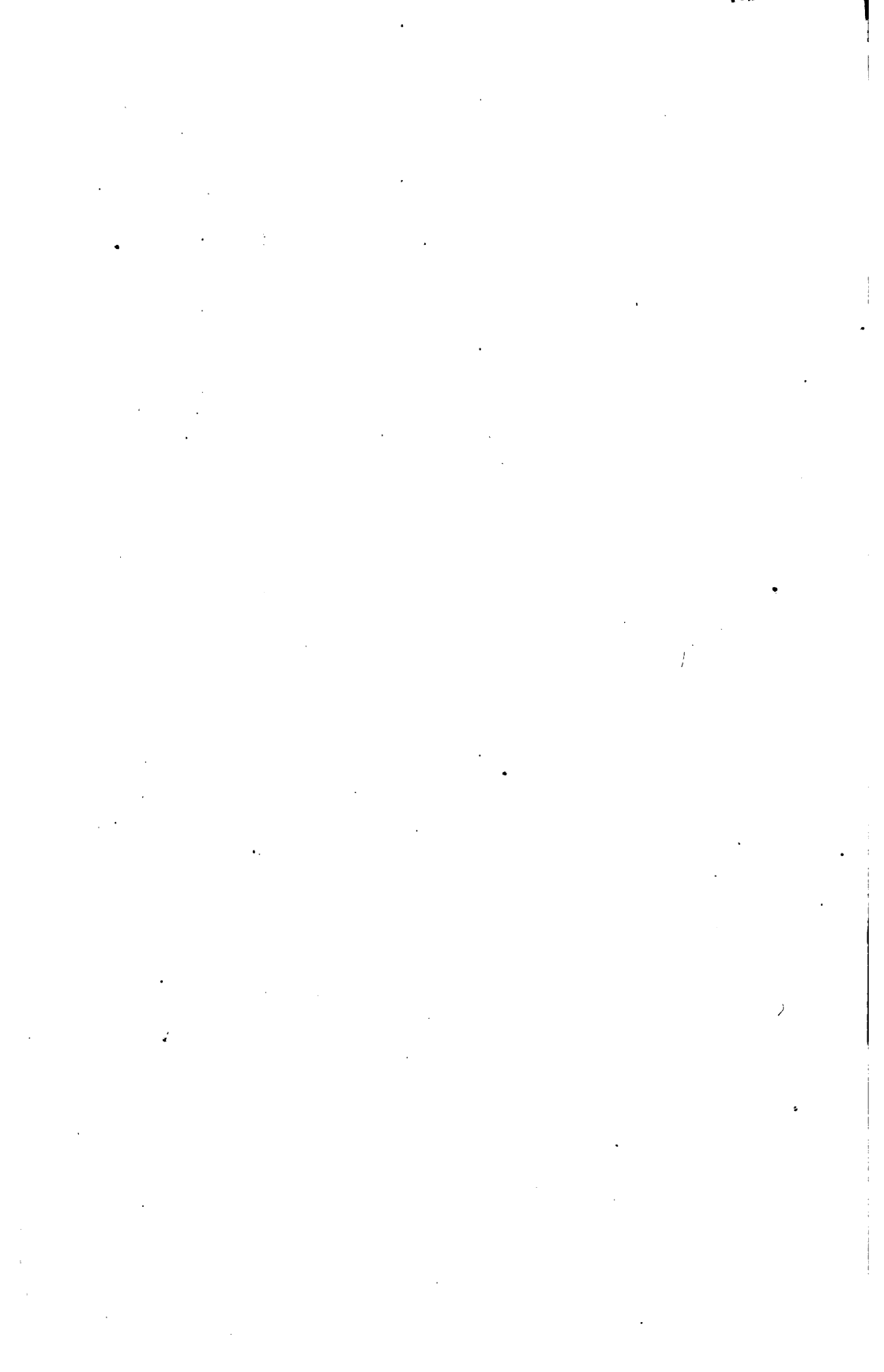
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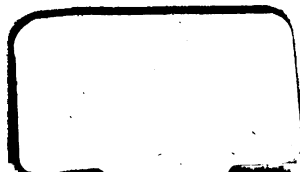
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